

FIG. 1

110 USER
114 TORQUE SENSATION
112 HAPTIC PRESENTATION DEVICE
113 PRESENTATION TORQUE
111 CONTROL DEVICE

書式変更：イタリア語（イ
タリア）

FIG. 2-1

213 SENSORY QUANTITY
211 SENSORY CHARACTERISTIC
214 OPERATION POINT A
215 OPERATION POINT B
212 PHYSICAL QUANTITY

FIG. 2-2

223 TORQUE
222 ROTATION VELOCITY OF ROTATOR
224 TORQUE SENSATION
227 INITIAL STATE
226 OPERATION POINT B DURATION TIME
225 OPERATION POINT A DURATION TIME
228 INITIAL STATE
221 TIME

FIG. 3-1

233 SENSORY QUANTITY
231 SENSORY CHARACTERISTIC
234 OPERATION POINT A
235 OPERATION POINT B
232 PHYSICAL QUANTITY

FIG. 3-2

243 TORQUE
242 ROTATION VELOCITY OF ROTATOR
244 TORQUE SENSATION
247 INITIAL STATE
246 OPERATION POINT B DURATION TIME
245 OPERATION POINT A DURATION TIME
248 INITIAL STATE
241 TIME

FIG. 4-1

313 SENSORY QUANTITY
314 OPERATION A
316 INITIAL OPERATION A
315 OPERATION B
312 DISPLACEMENT
311 HYSTERESIS SENSORY CHARACTERISTIC

HYSTERESIS: SENSORY QUANTITY IS DIFFERENT BETWEEN INCREASE AND
DECREASE OF DISPLACEMENT

FIG. 4-2

324 OPERATION A

325 OPERATION B

FIG. 4-3

333 TORQUE

332 ROTATION VELOCITY OF ROTATOR

334 TORQUE SENSATION

337 INITIAL STATE

335 OPERATION PASSAGE A DURATION TIME

336 OPERATION PASSAGE B DURATION TIME

338 INITIAL STATE

331 TIME

FIG. 5-1

413 TORQUE

412 ROTATION VELOCITY OF ROTATOR

411 TIME

415 INITIALIZATION TIME

FIG. 5-2

423 MASKING VIBRATION

425 MASKING DURATION TIME

424 SIMULTANEOUS MASKING VIBRATION

425 FORWARD MASKING VIBRATION
426 BACKWARD MASKING VIBRATION
421 TIME

FIG. 5-3

434 TORQUE SENSATION
431 TIME

FIG. 6-1

443 TORQUE
442 ROTATION VELOCITY OF ROTATOR
441 TIME
444 PRESENT TIME
445 INITIALIZATION TIME

FIG. 6-2

453 MASKING VIBRATION
455 MASKING DURATION TIME
454 SIMULTANEOUS MASKING VIBRATION
455 FORWARD MASKING VIBRATION
456 BACKWARD MASKING VIBRATION
451 TIME

FIG. 6-3

464 TORQUE SENSATION

461 TIME

FIG. 7-1

473 TORQUE

471 TIME

FIG. 7-2

484 TORQUE SENSATION

486 INTENSE TORQUE SENSATION

485 INTENSE TORQUE SENSATION

486 BACKWARD MASKING

485 FORWARD MASKING

481 TIME

FIG. 8-1

515 MUSCLE CAUSE TORQUE

511 MYOELECTRICITY

516 PRESENTATION TORQUE

517 TORQUE SENSATION

513 HAPTIC PRESENTATION DEVICE

514 PRESENTATION TORQUE

512 CONTROL CIRCUIT

FIG. 8-2

524 HIGH TORQUE IN SHORT TIME

526 GENTLE MIDDLE TORQUE
525 MUSCLE REFLEX CAUSE TORQUE

FIG. 9

612 ROTATION VELOCITY ω
611 ANISOTROPIC SENSITIVITY CURVE

FIG. 10-1

711 ECCENTRIC ROTATOR

FIG. 10-2

721 ECCENTRIC ROTATOR
724 OPERATION POINT A
725 OPERATION POINT B
722 CHARACTERISTIC CURVE OF INEQUALITY ROTATIONVELOCITY ω

FIG. 10-3

733 SENSORY QUANTITY
731 SENSORY CHARACTERISTIC
734 OPERATION POINT A
735 OPERATION POINT B
732 PHYSICAL QUANTITY

FIG. 10-4

743 TORQUE

744 TORQUE SENSATION
 742 ROTATION VELOCITY OF ECCENTRIC ROTATOR
 740 TIME
 748 INITIAL STATE
 747 INITIAL STATE
 745 OPERATION POINT A DURATION TIME
 746 OPERATION POINT B DURATION TIME

FIG. 11-1

812 ECCENTRIC ROTATOR A
 813 ECCENTRIC ROTATOR B
 811 TWIN ECCENTRIC ROTATOR

書式変更：イタリア語（イタリア）

FIG. 11-2

822 ROTATION VELOCITY ω_2+ OF ECCENTRIC ROTATOR A
 823 ROTATION VELOCITY ω_2- OF ECCENTRIC ROTATOR B
 821 PHASE RELATION OF TWIN ECCENTRIC ROTATOR FOR VIBRATION
 PRESENTATION

FIG. 11-3

832 ROTATION VELOCITY ω_2+ OF ECCENTRIC ROTATOR A
 833 ROTATION VELOCITY ω_2- OF ECCENTRIC ROTATOR B
 831 PHASE RELATION OF TWIN ECCENTRIC ROTATOR FOR TORQUE
 PRESENTATION

FIG. 11-4

842 ROTATION VELOCITY ω_2+ OF ECCENTRIC ROTATOR A
843 ROTATION VELOCITY ω_2- OF ECCENTRIC ROTATOR B
841 PHASE RELATION OF TWIN ECCENTRIC ROTATOR FOR FORE
PRESENTATION

FIG. 12-1

854 RESULTANT BARYCENTER
855 RESULTANT BARYCENTER
856 RESULTANT BARYCENTER
851 PHASE DIFFERENCE 0°
852 PHASE DIFFERENCE 90°
853 PHASE DIFFERENCE 180°
857 BARYCENTER MOMENT LENGTH L1
858 BARYCENTER MOMENT LENGTH L2
859 BARYCENTER MOMENT LENGTH L3

FIG. 12-2

861 PHASE 0°
862 PHASE 45°
863 PHASE 90°
864 PHASE 135°
865 PHASE 180°
866 AMPLITUDE A1
867 AMPLITUDE A2

書式変更：イタリア語（イ
タリア）

FIG. 14

880 SHEET-SHAPED ECCENTRIC ROTATOR ARRAY

881 ECCENTRIC ROTATOR X

882 ECCENTRIC ROTATOR Y

883 ECCENTRIC ROTATOR Z

884 TWIN ECCENTRIC ROTATOR X_L

885 TWIN ECCENTRIC ROTATOR Y_L

886 TWIN ECCENTRIC ROTATOR Z_L

887 TWIN ECCENTRIC ROTATOR XYZ_L

書式変更 : イタリア語 (イタリア)

FIG. 15

890 GLOVE-SHAPED ECCENTRIC ROTATOR ARRAY

891 SHEET-SHAPED ECCENTRIC ROTATOR ARRAY

FIG. 16-1

912 ECCENTRIC ROTATOR A

913 ECCENTRIC ROTATOR B

911 TWIN ECCENTRIC ROTATOR

FIG. 16-2

922 ROTATION VELOCITY ω_2+ OF ECCENTRIC ROTATOR A

923 ROTATION VELOCITY ω_2- OF ECCENTRIC ROTATOR B

921 PHASE RELATION OF TWIN ECCENTRIC ROTATOR FOR TORQUE PRESENTATION

FIG. 16-3

931 SENSORY CHARACTERISTIC
933 SENSORY QUANTITY
934 OPERATION POINT A
935 OPERATION POINT B
932 PHYSICAL QUANTITY

FIG. 16-4

943 TORQUE
944 TORQUE SENSATION
942 ROTATION VELOCITY OF ECCENTRIC ROTATOR
940 TIME
948 INITIAL STATE
947 INITIAL STATE
945 OPERATION POINT A DURATION TIME
946 OPERATION POINT B DURATION TIME

FIG. 17-1

1012 ECCENTRIC ROTATOR A
1013 ECCENTRIC ROTATOR B
1011 TWIN ECCENTRIC ROTATOR

書式変更：イタリア語（イ
タリア）

FIG. 17-2

1022 ROTATION VELOCITY ω_2 OF ECCENTRIC ROTATOR A

1023 ROTATION VELOCITY ω_2 - OF ECCENTRIC ROTATOR B

1021 PHASE RELATION OF TWIN ECCENTRIC ROTATOR FOR FORCE
PRESENTATION

FIG. 17-3

1031 SENSORY CHARACTERISTIC

1033 SENSORY QUANTITY

1034 OPERATION POINT A

1035 OPERATION POINT B

1032 PHYSICAL QUANTITY

FIG. 17-4

1042 MAGNITUDE OF RESULTANT ROTATION VELOCITY OF TWO
ECCENTRIC ROTATORS

1041 ROTATION VELOCITY OF ECCENTRIC ROTATOR

1040 TIME

1043 FORCE

1044 FORCE SENSATION

1047 INITIAL STATE

1048 INITIAL STATE

1045 OPERATION POINT A DURATION TIME

1046 OPERATION POINT B DURATION TIME

FIG. 18-1

1111 TWIN ECCENTRIC ROTATOR

1112 TWIN ECCENTRIC ROTATOR

1113 FORCE

1114 FORCE

FIG. 18-2

1121 TWIN ECCENTRIC ROTATOR

1122 TWIN ECCENTRIC ROTATOR

1123 FORCE

1124 FORCE

FIG. 18-3

1131 TWIN ECCENTRIC ROTATOR

1132 TWIN ECCENTRIC ROTATOR

1133 FORCE

1134 FORCE

FIG. 18-4

1141 TWIN ECCENTRIC ROTATOR

1142 TWIN ECCENTRIC ROTATOR

1143 FORCE

1144 FORCE

FIG. 18-5

1151 TWIN ECCENTRIC ROTATOR

1153 FORCE

FIG. 18-6

1161 TWIN ECCENTRIC ROTATOR

1163 FORCE

FIG. 19

1170 GROOVE-SHAPED ECCENTRIC ROTATOR ARRAY

1171 SKIN-SHAPED ECCENTRIC ROTATOR ARRAY

SKIN

1173 FORCE

1174 SHEAR FORCE

1175 TORQUE

1172 TWIN ECCENTRIC ROTATOR

FIG. 20

1185 RESULTANT TORQUE

1181 SKIN-SHAPED ECCENTRIC ROTATOR ARRAY

FIG. 21

1191 SPHERICAL RESISTING FORCE

1193 RESISTING FORCE

1192 CUBIC RESISTING FORCE

FIG. 22

1195 FEELING IN WHICH FORCE IS TRANSMITTED ON PALM

1196 FORCE FEELING IN WHICH FORCE PASSES THROUGH PALM

FIG. 23-1

1213 FORCE

1212 MAGNITUDE OF RESULTANT ROTATION VELOCITY OF TWO
ECCENTRIC ROTATORS

1211 TIME

1216 MASKING VIBRATION

FIG. 23-2

1215 INITIALIZATION TIME

1224 FORCE SENSATION

1221 TIME

FIG. 23-3

1233 FORCE

1232 MAGNITUDE OF RESULTANT ROTATION VELOCITY OF TWO
ECCENTRIC ROTATORS

1231 TIME

1236 MASKING VIBRATION

FIG. 23-4

1234 PRESENTATION TIME

1235 INITIALIZATION TIME

1244 FORCE SENSATION

1241 TIME

FIG. 24-1

1311 GYROSCOPE TYPE

FIG. 24-2

1312 RESULTANT ANGULAR MOMENTUM VECTOR DIFFERENTIAL TYPE

FIG. 25

1333 TURNING VELOCITY VECTOR OF TURNING COORDINATE

1332 RESULTANT ANGULAR MOMENTUM VECTOR

1331 TURNING COORDINATE SYSTEM

1330 INERTIA COORDINATE SYSTEM

FIG. 26-1

1341 VIBRATION

FIG. 26-2

1342 ONE-DIMENSIONAL TORQUE PRESENTATION

FIG. 26-3

1343 TWO-DIMENSIONAL TORQUE PRESENTATION

FIG. 26-4

1344 THREE-DIMENSIONAL TORQUE PRESENTATION

FIG. 27

1351 STABILIZER

FIG. 28

TWO-DIMENSIONAL SECTIONAL VIEW OF HAPTIC PRESENTATIONDEVICE

(EXPANSION MAY BE MADE TO THREE DIMENSIONS)

2803 MOTOR BODY

2802 ROTATING SHAFT

2804 INERTIA

FIG. 29

TWO-DIMENSIONAL SECTIONAL VIEW OF HAPTIC PRESENTATIONDEVICE

(EXPANSION MAY BE MADE TO THREE DIMENSIONS)

2803 MOTOR BODY

2802 ROTATING SHAFT

2910 NARROWING HOLE

2908 TURBINE FIN

2909 GAS FLOW/LIQUID FLOW

2804 INERTIA

FIG. 30

TWO-DIMENSIONAL SECTIONAL VIEW OF HAPTIC PRESENTATIONDEVICE

(EXPANSION MAY BE MADE TO THREE DIMENSIONS)

2803 MOTOR BODY

2802 ROTATING SHAFT

2910 NARROWING HOLE

GAS FLOW

3009 AIR

2804 INERTIA

2908 TURBINE FIN

3010 VALVE

FIG. 31

3111 SHEET-SHAPED ECCENTRIC ROTATOR ARRAY

315a RESULTANT TORQUE

315b RESULTANT TORQUE

3110 GLOVE-SHAPED ECCENTRIC ROTATOR ARRAY

FIG. 32

TWO-DIMENSIONAL SECTIONAL VIEW OF HAPTIC PRESENTATION DEVICE

(EXPANSION MAY BE MADE TO THREE DIMENSIONS)

3206 ANGULAR ACCELERATION SENSOR

2803 MOTOR BODY

2802 ROTATING SHAFT

2804 INERTIA

3205 CONTROL CIRCUIT

FIG. 33(a)

3350 TOUCH PANEL

FIG. 34

3430 POSTURE SENSOR
3420 CONTROL CIRCUIT
3410 HAPTIC PRESENTATION DEVICE
3440 PEN-SHAPED DEVICE CONTROL CIRCUIT
3350 TOUCH PANEL

FIG. 35

3540 POINTER CONTROL CIRCUIT
3510 HAPTIC PRESENTATION DEVICE
3520 CONTROL CIRCUIT
3530 POSTURE SENSOR

FIG. 36

3601 BATON-TYPE CONTROLLER
3610 HAPTIC PRESENTATION DEVICE
3620 CONTROL CIRCUIT
3630 POSTURE SENSOR
3640 CONTROLLER CONTROL CIRCUIT

FIG. 40

4030 POSTURE SENSOR
4020 CONTROL CIRCUIT
4010 HAPTIC PRESENTATION DEVICE

FIG. 41

4110 HAPTIC PRESENTATION DEVICE

4180 ROTATOR

CONTROL

4120 CONTROL DEVICE

4150 CONTROL PROGRAM

INPUT

4130 INPUT DEVICE

FIG. 1

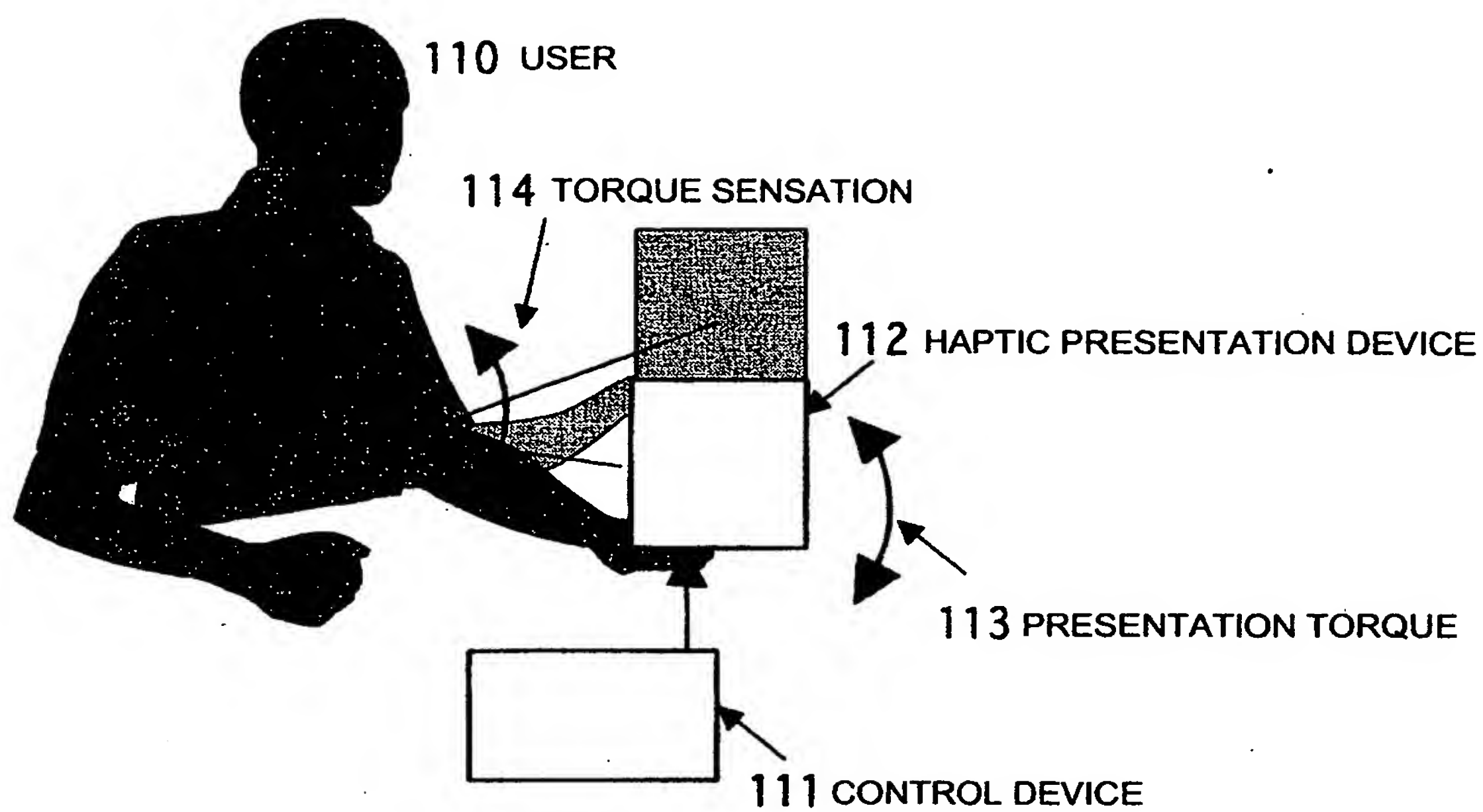


FIG. 2 - 1

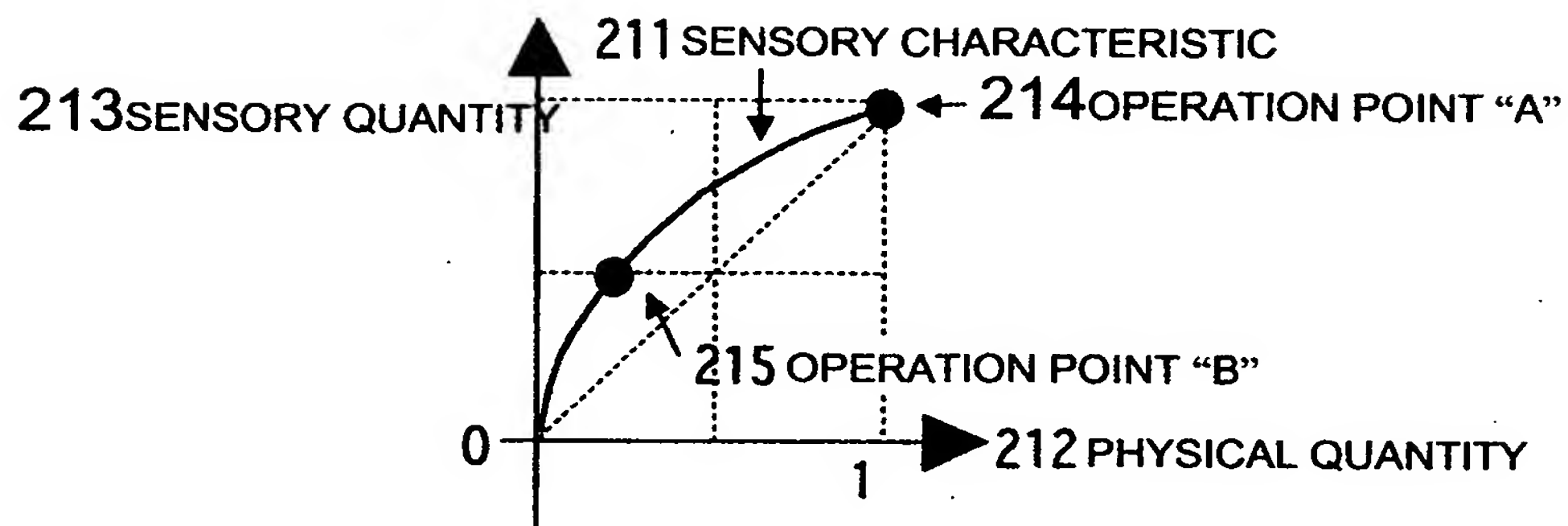


FIG. 2 - 2

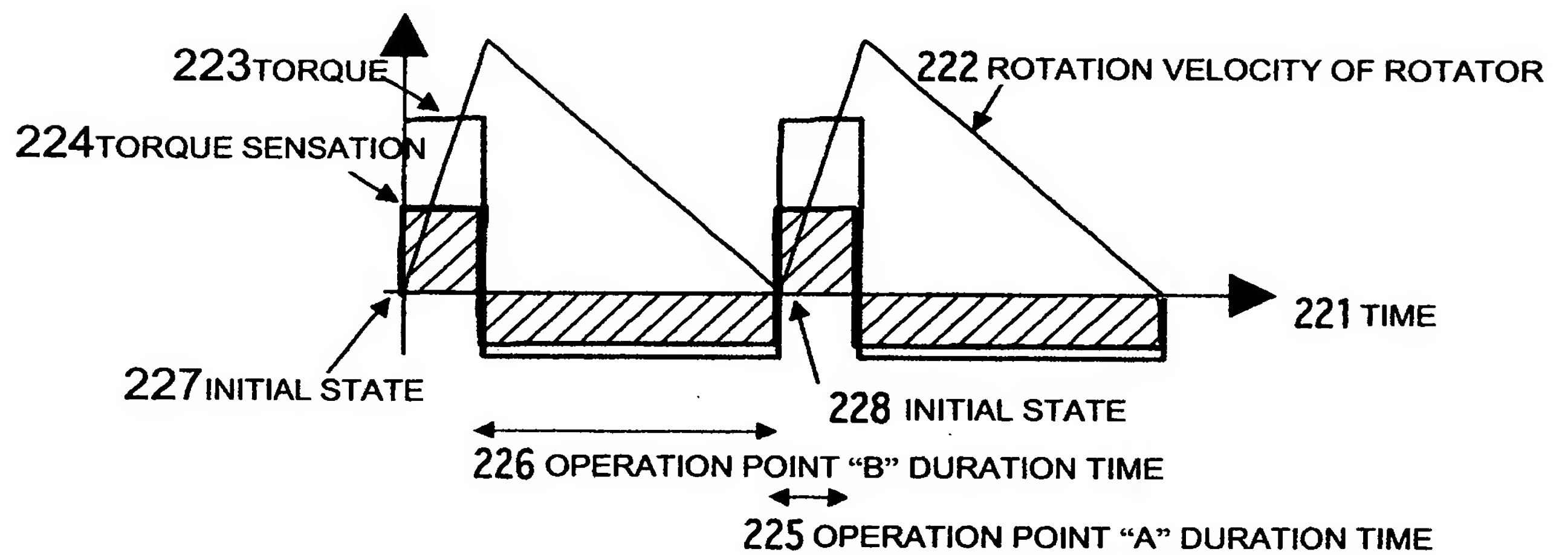


FIG. 3 - 1

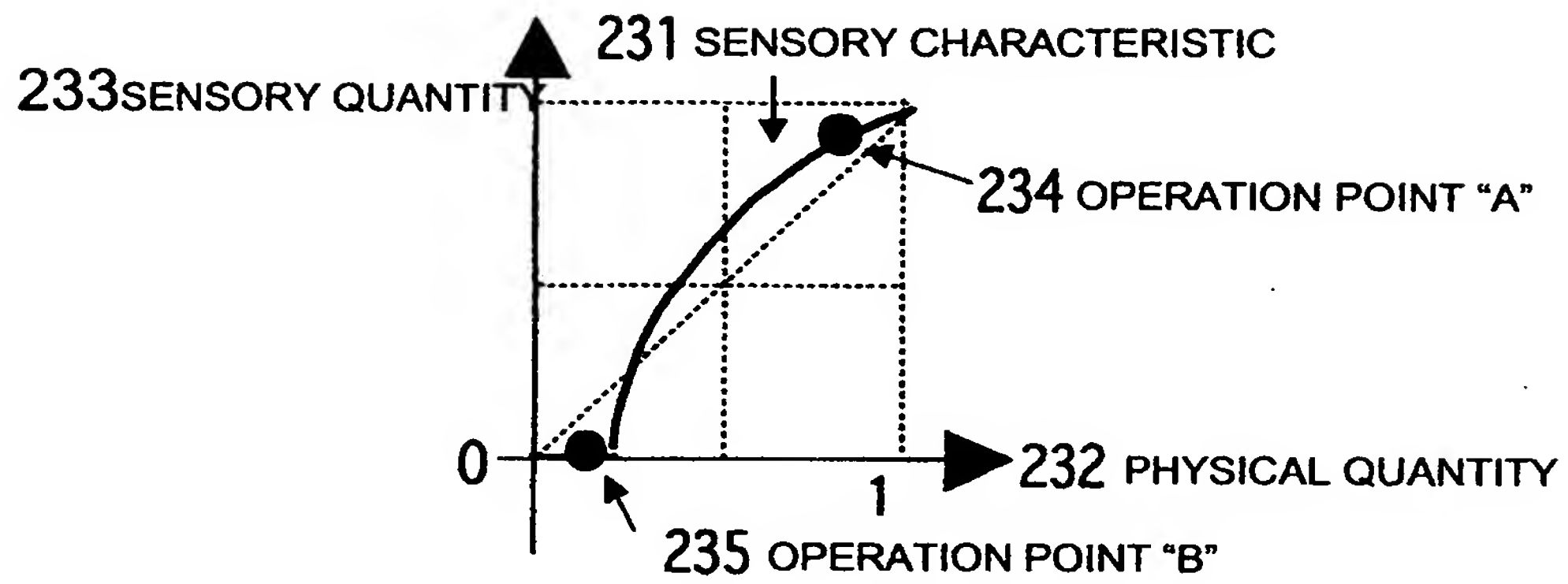


FIG. 3 - 2

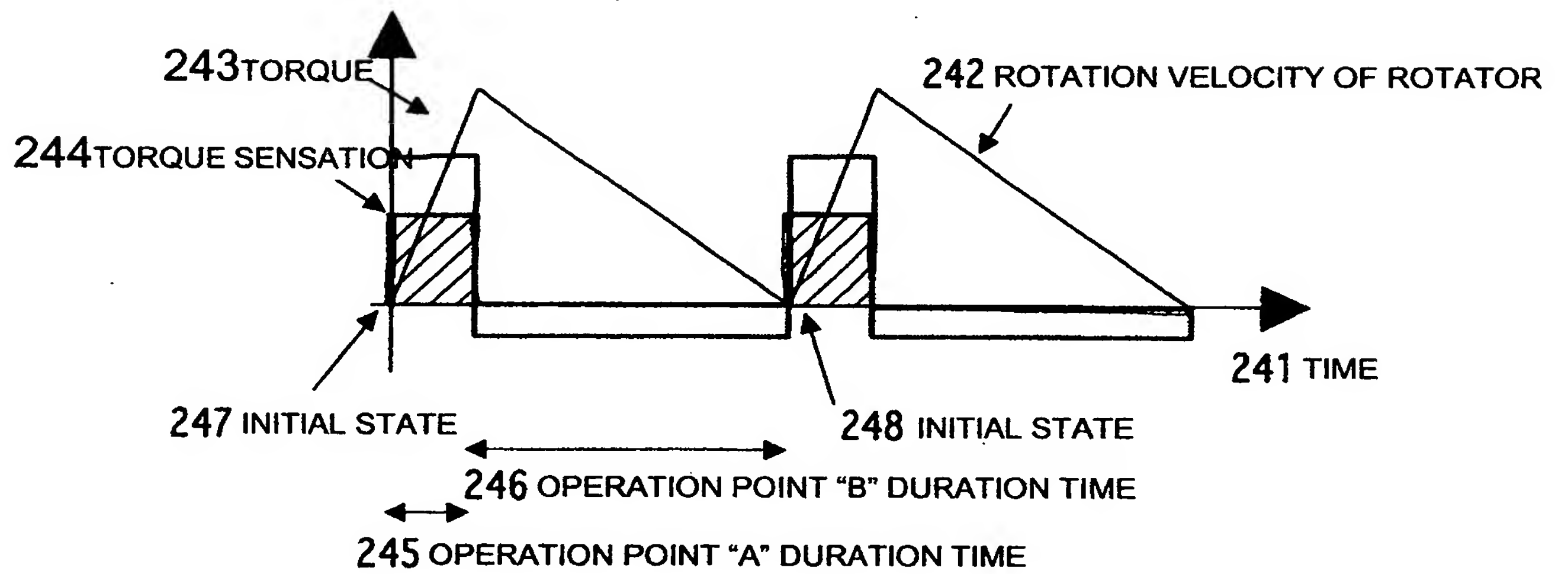
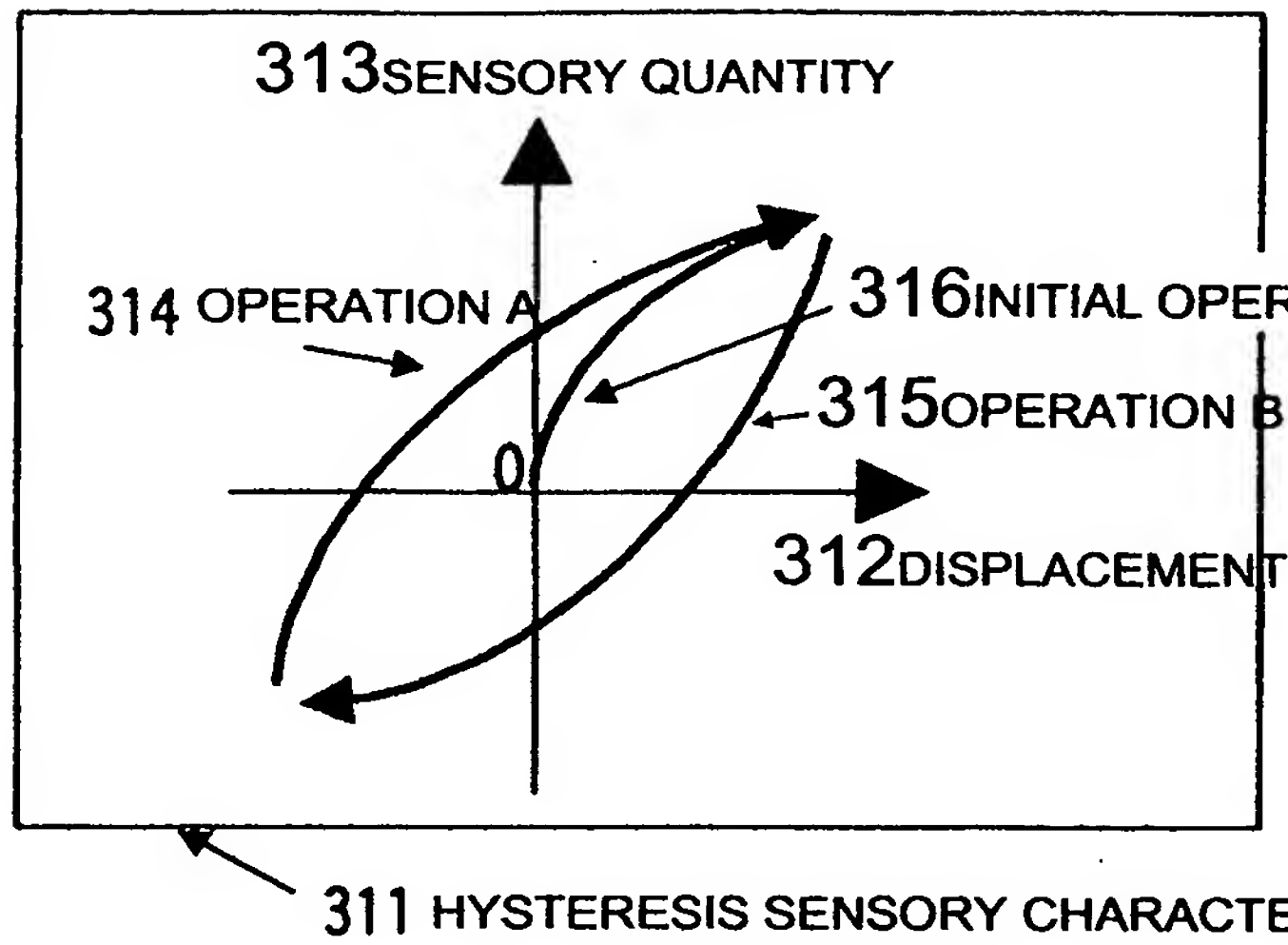


FIG. 4 - 1



※ HYSTERESIS:
SENSORY QUANTITY IS DIFFERENT BETWEEN INCREASE AND
DECREASE OF DISPLACEMENT

FIG. 4 - 2

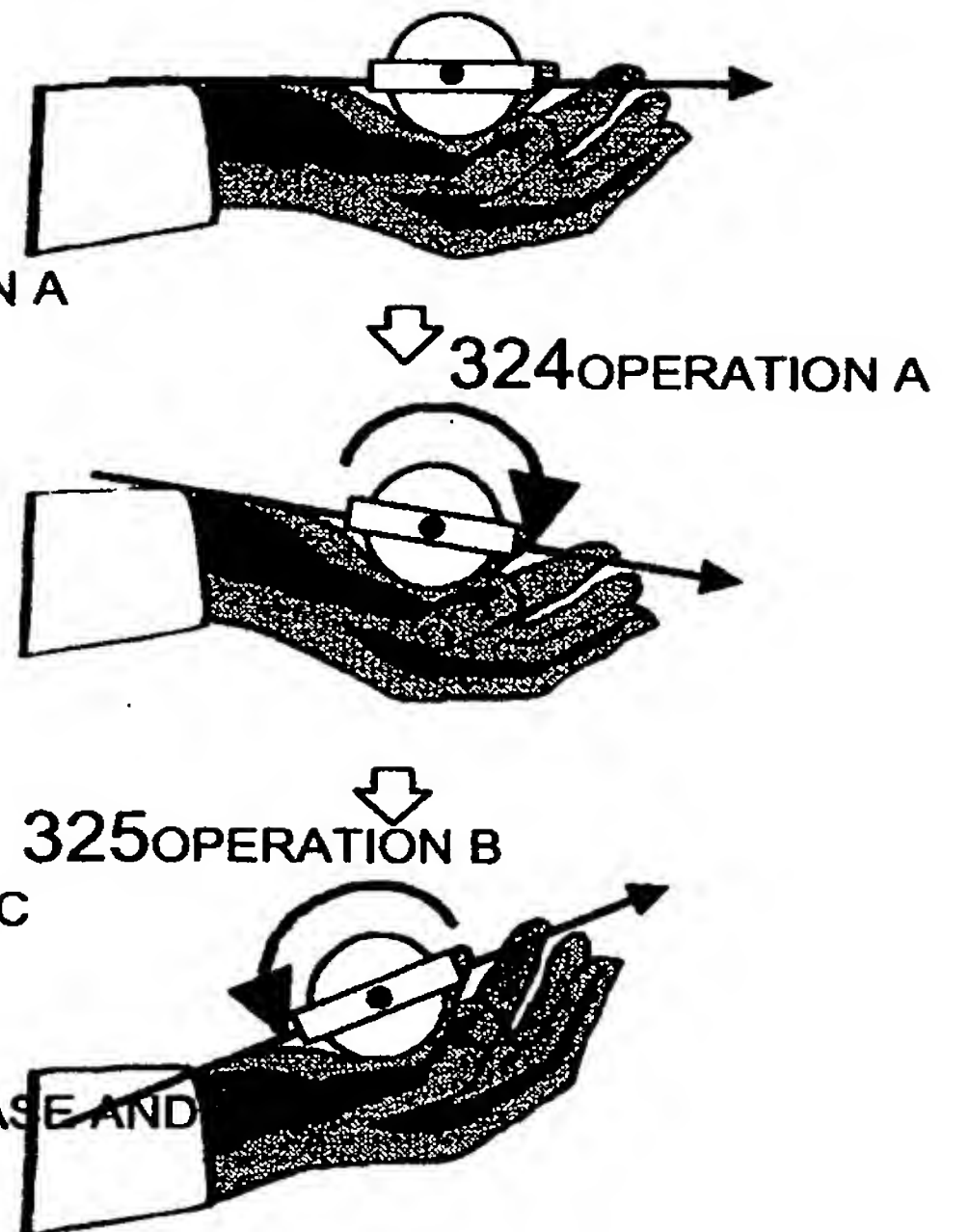


FIG. 4 - 3

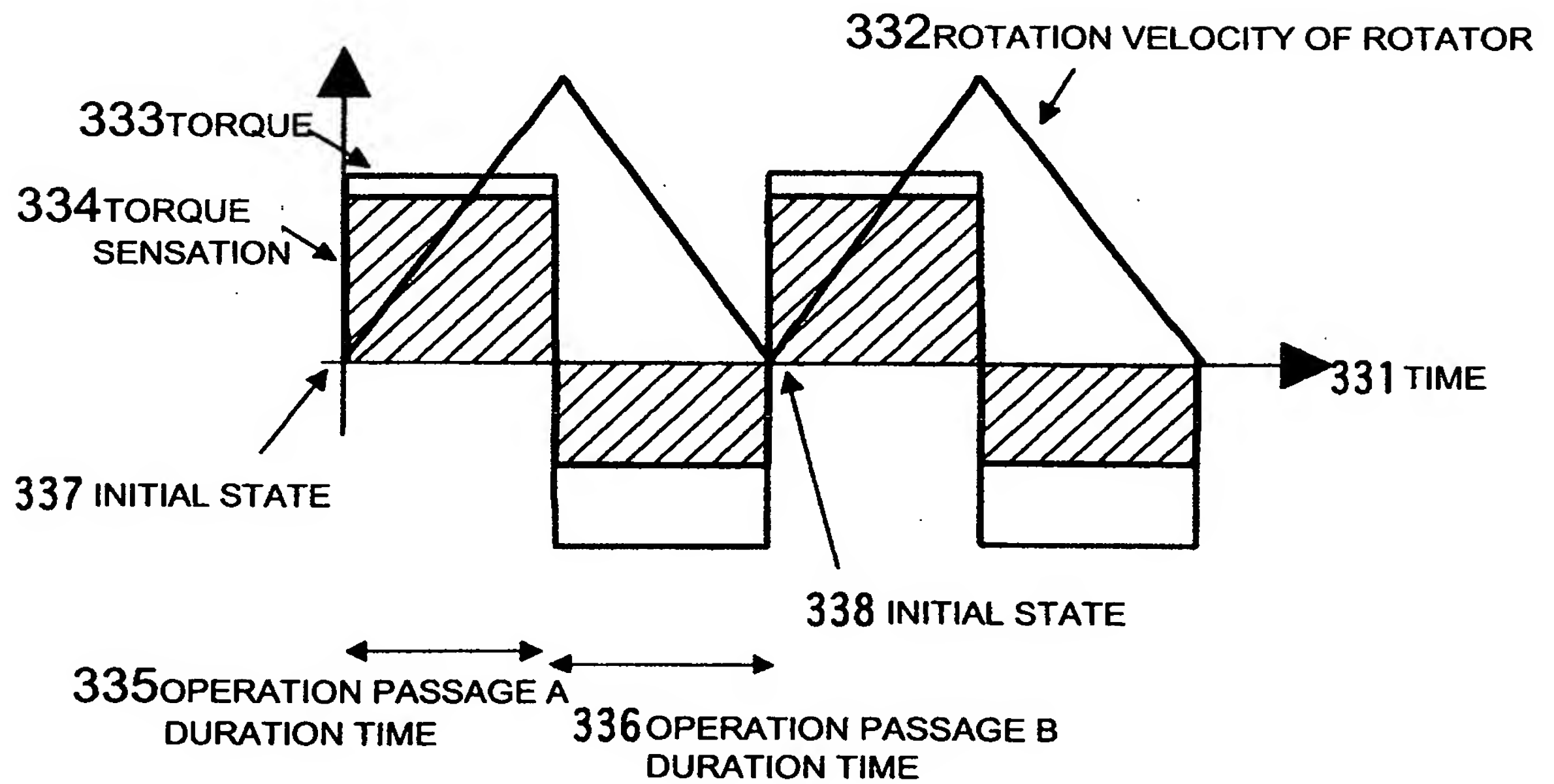


FIG. 5 - 1

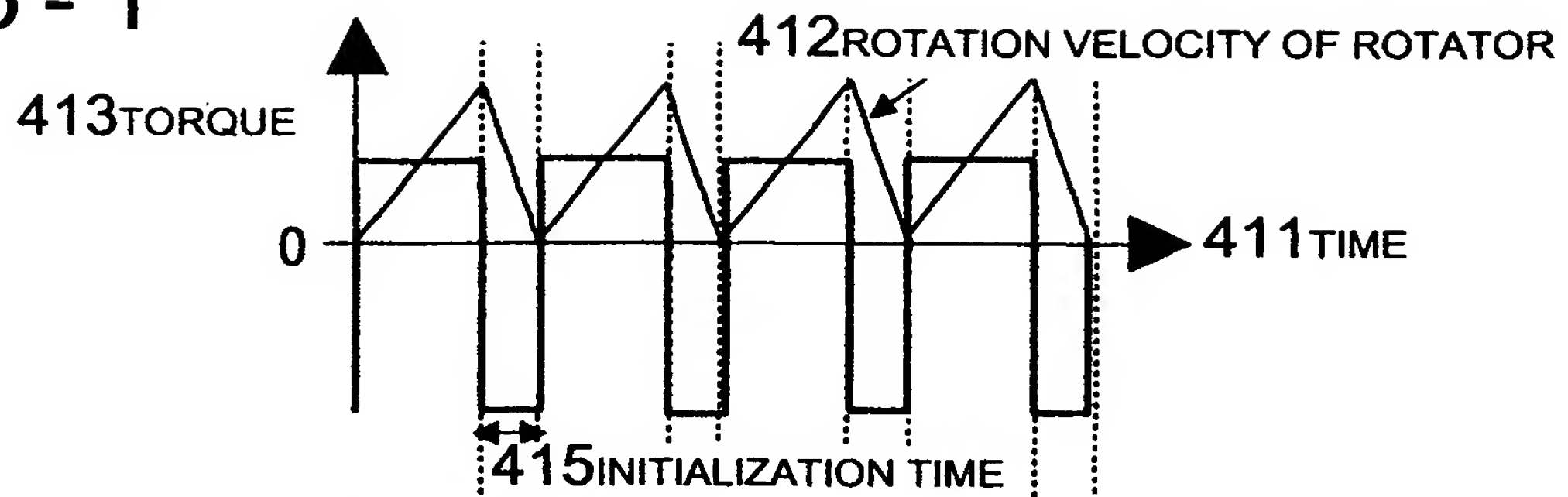


FIG. 5 - 2

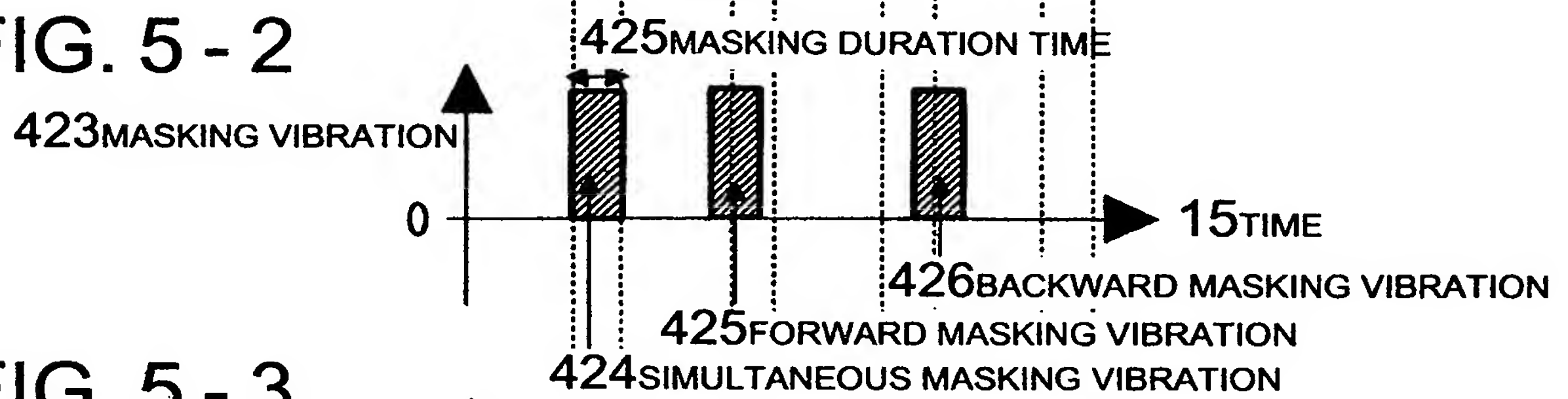


FIG. 5 - 3

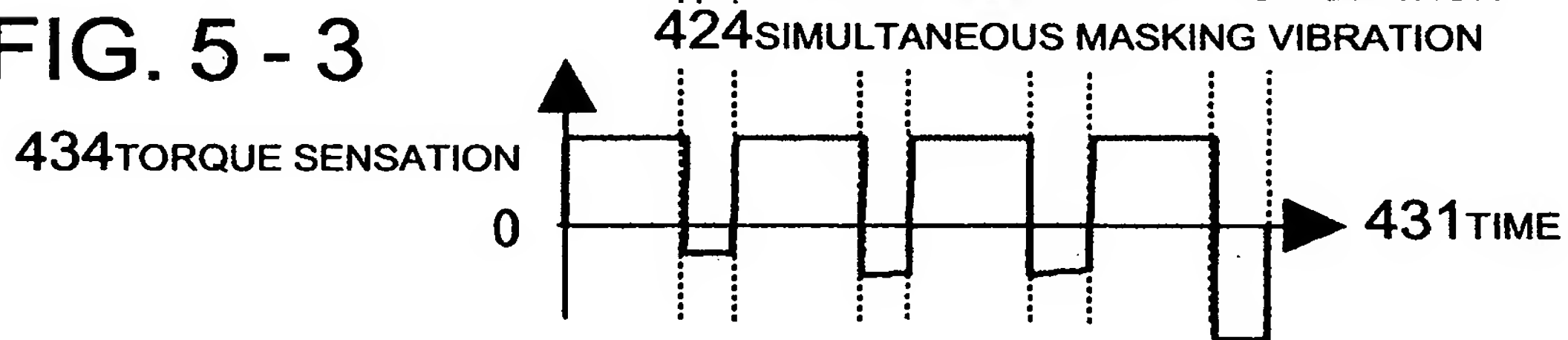


FIG. 6 - 1

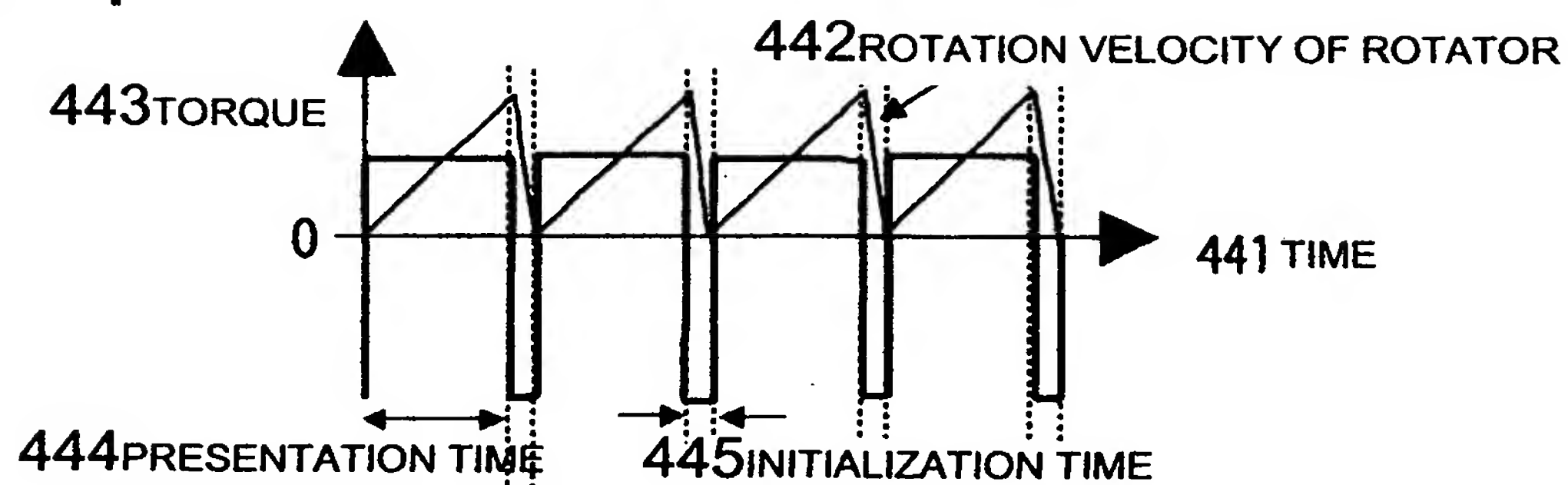


FIG. 6 - 2

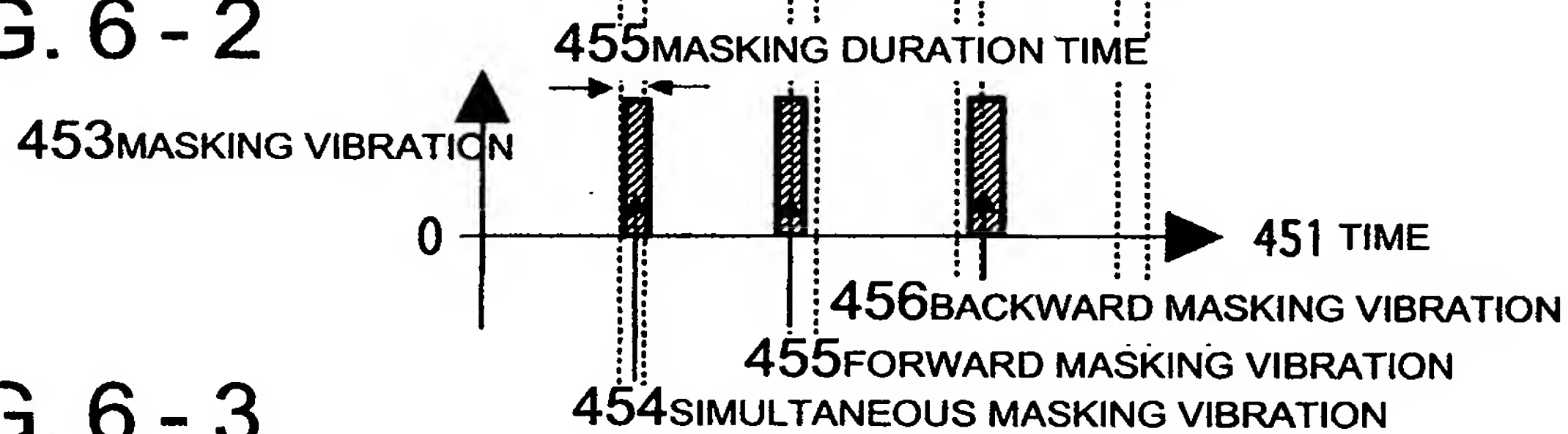


FIG. 6 - 3

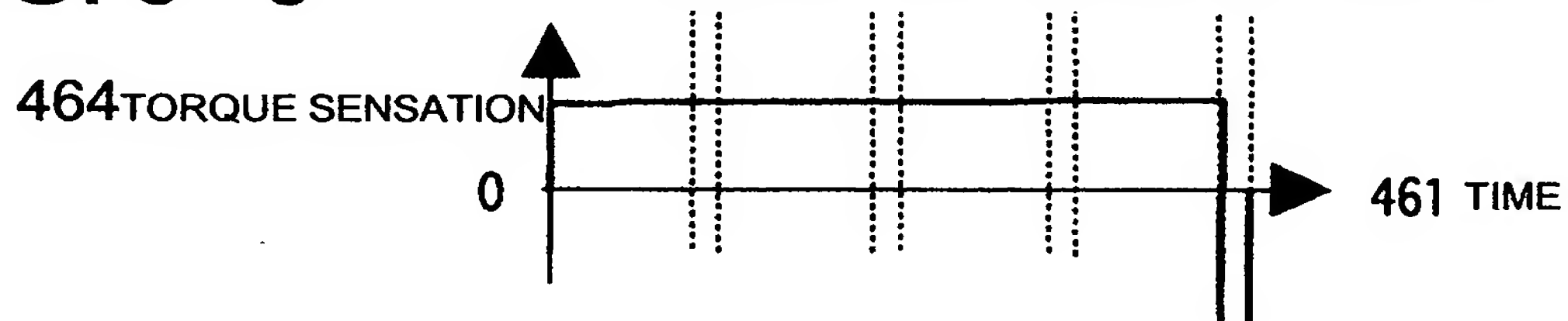


FIG. 7 - 1

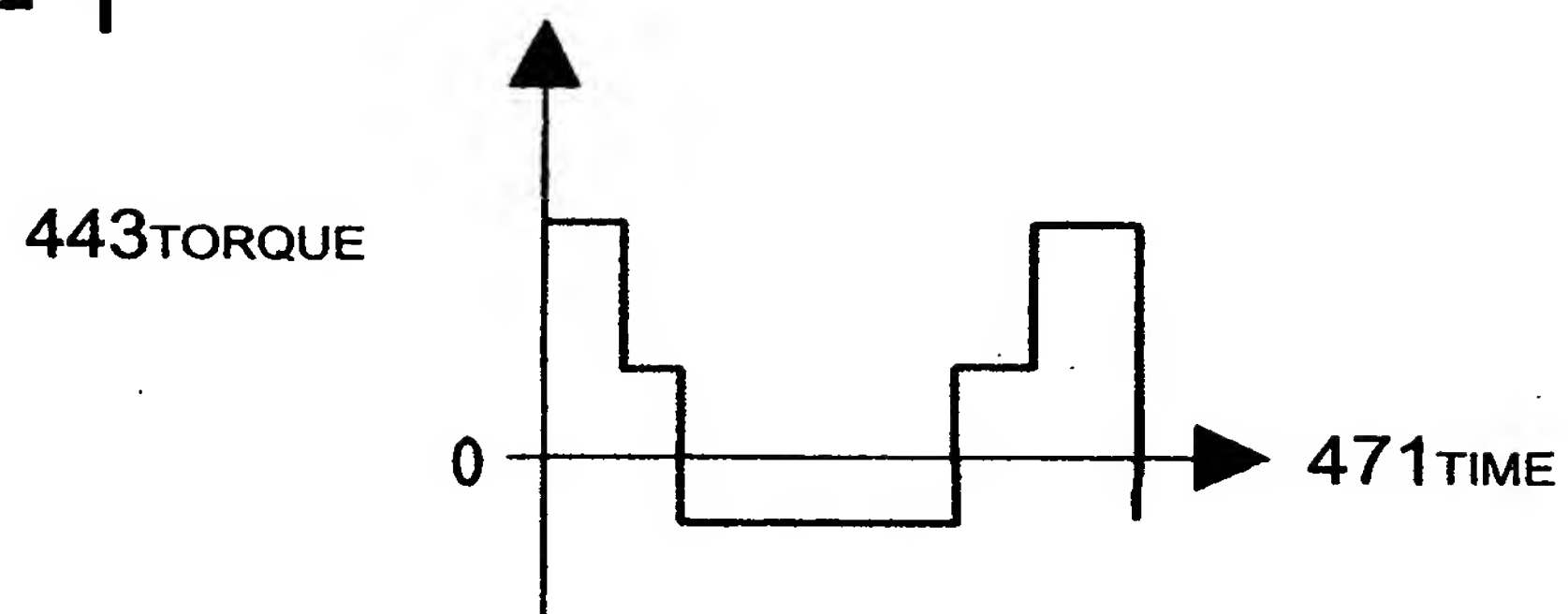


FIG. 7 - 2

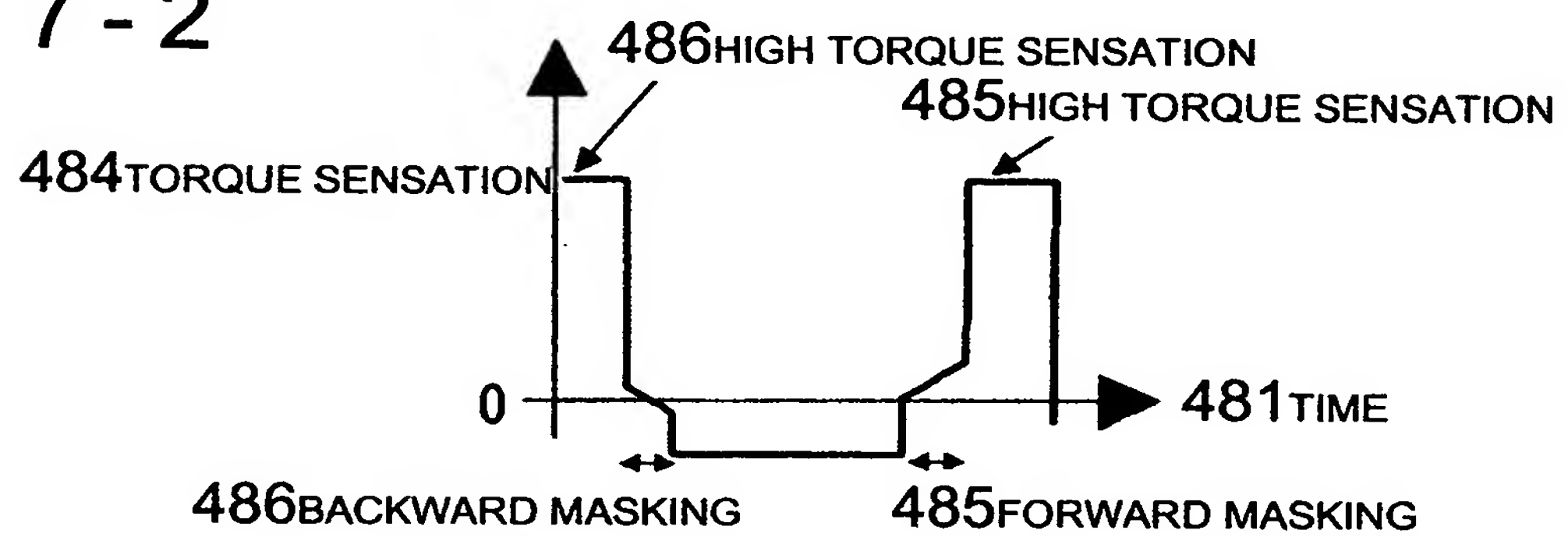


FIG. 8-1

FIG. 8-2

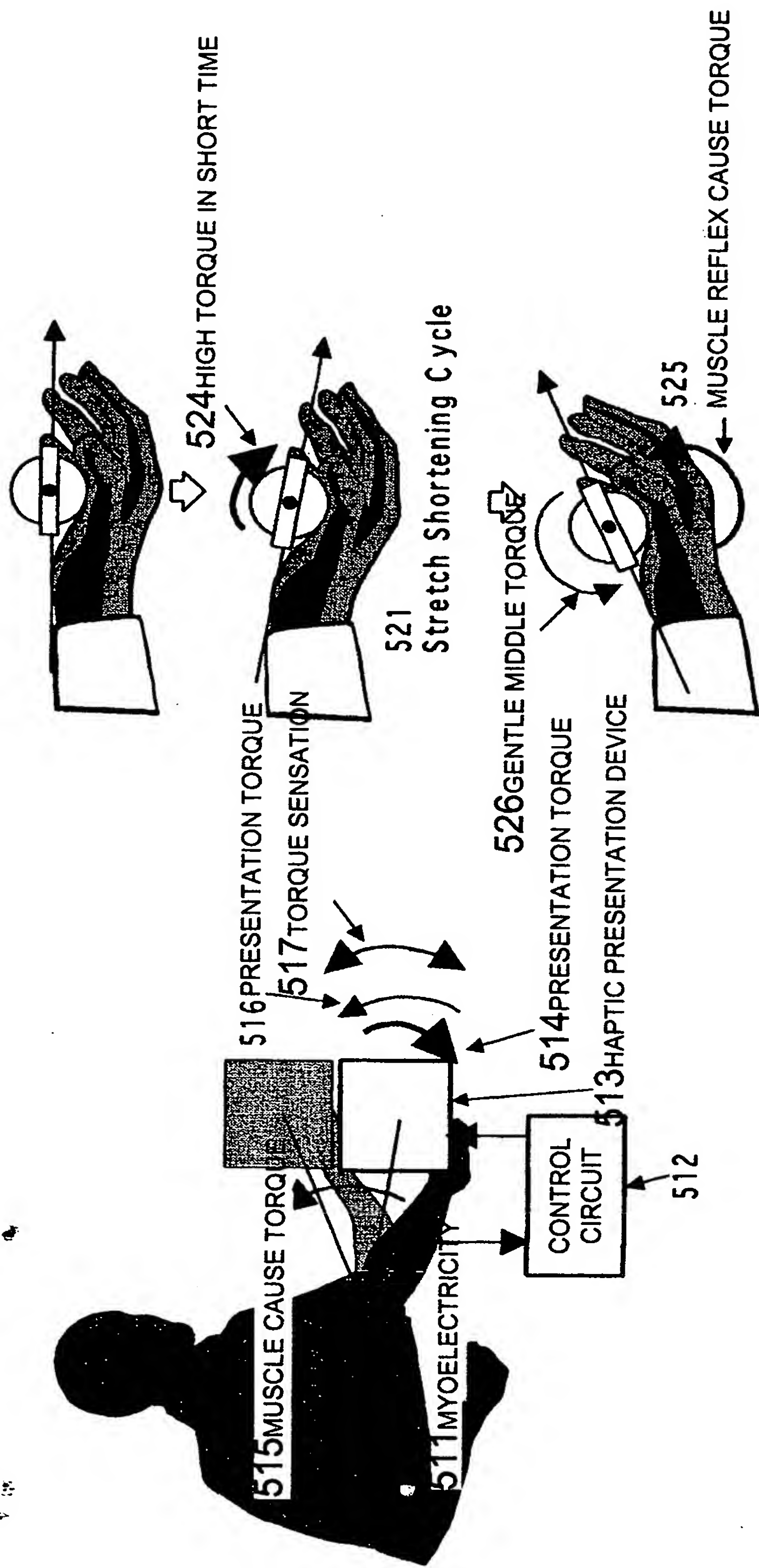


FIG. 9

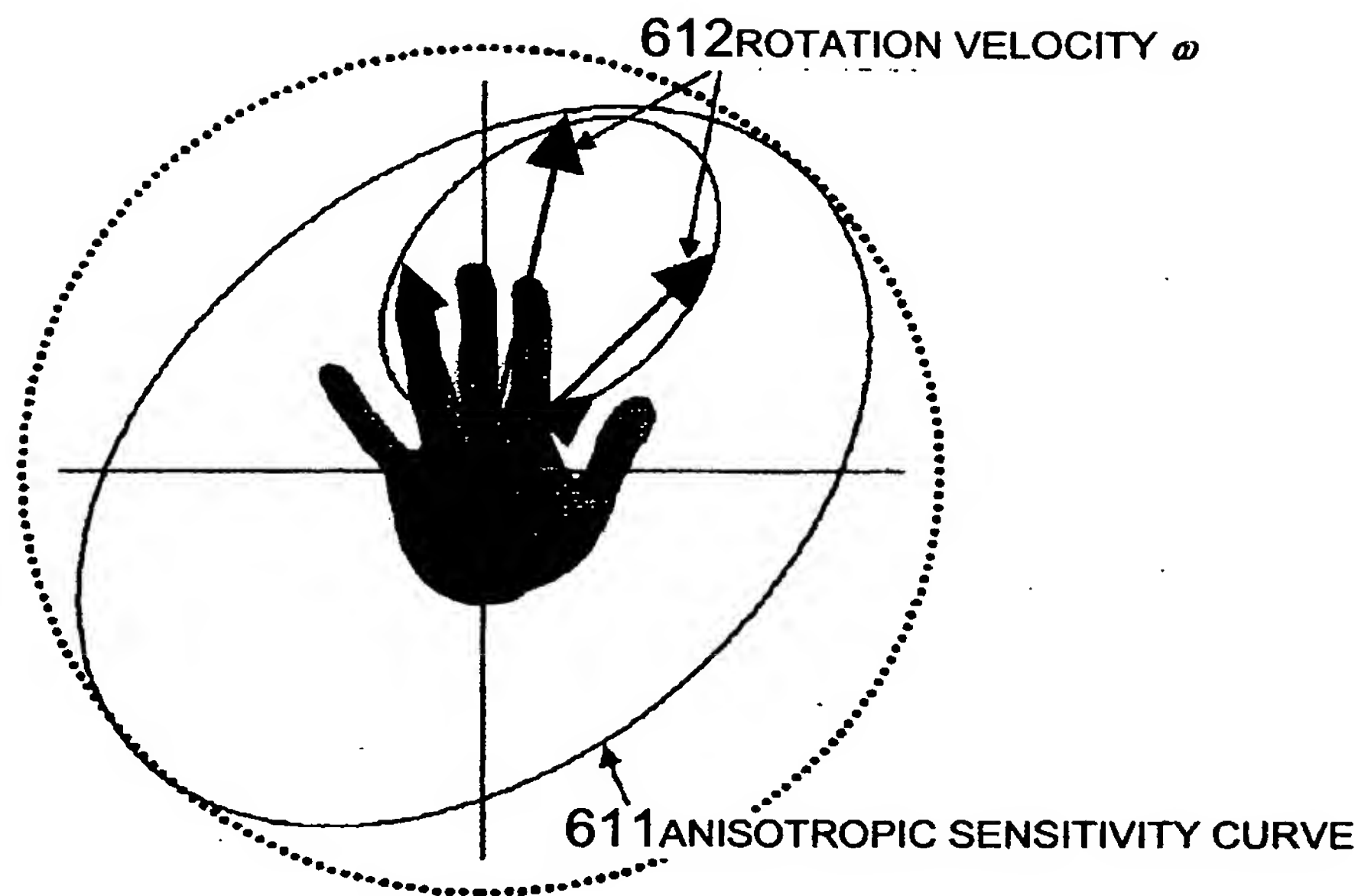


FIG. 1 0 - 1

FIG. 1 0 - 3

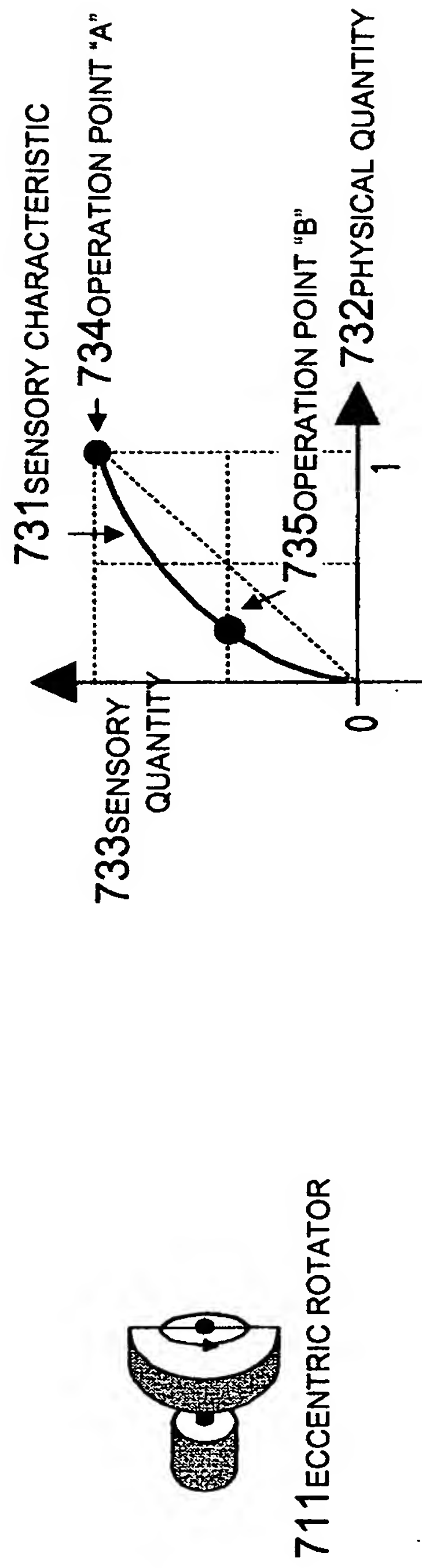


FIG. 1 0 - 2

FIG. 1 0 - 4

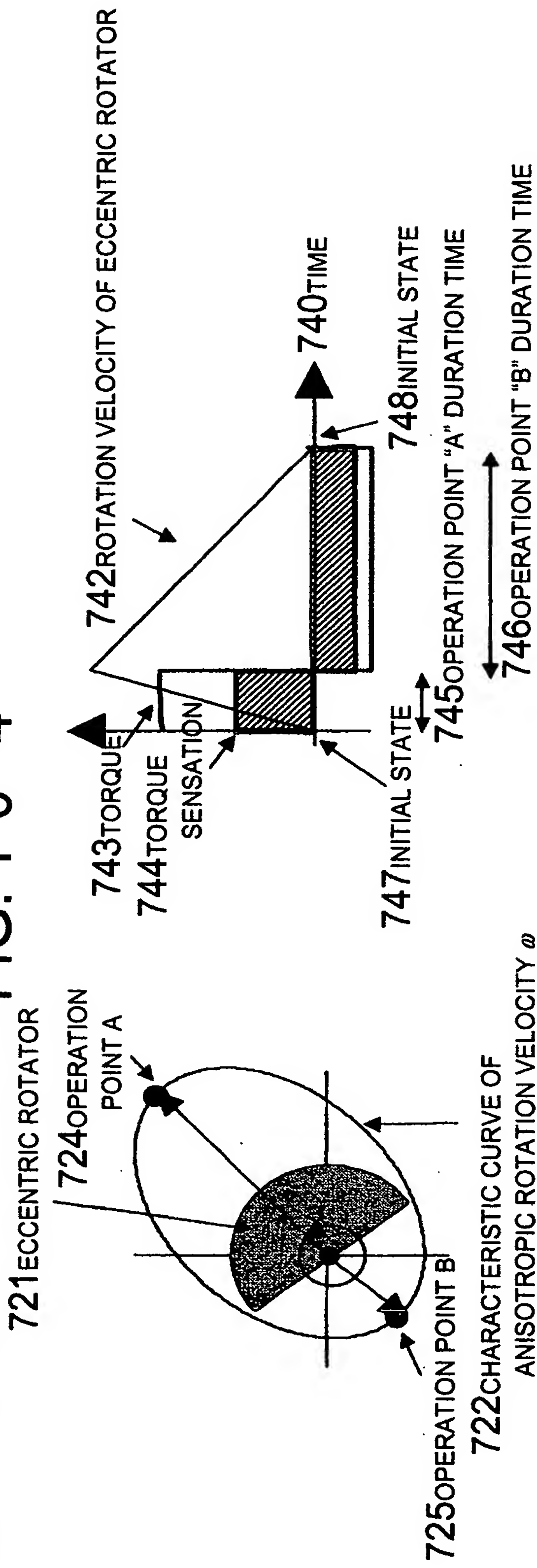
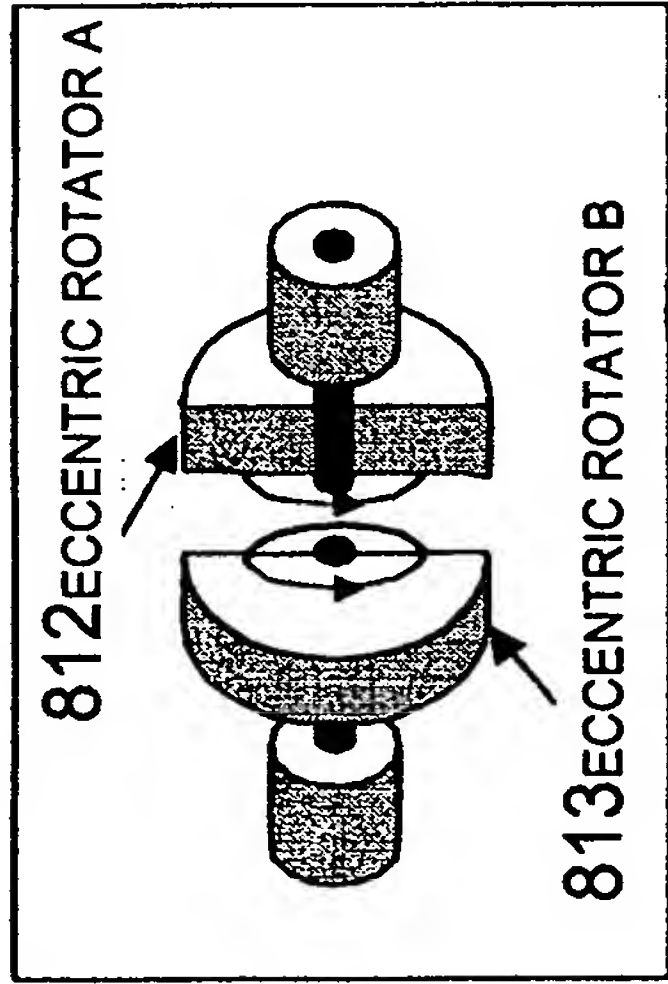
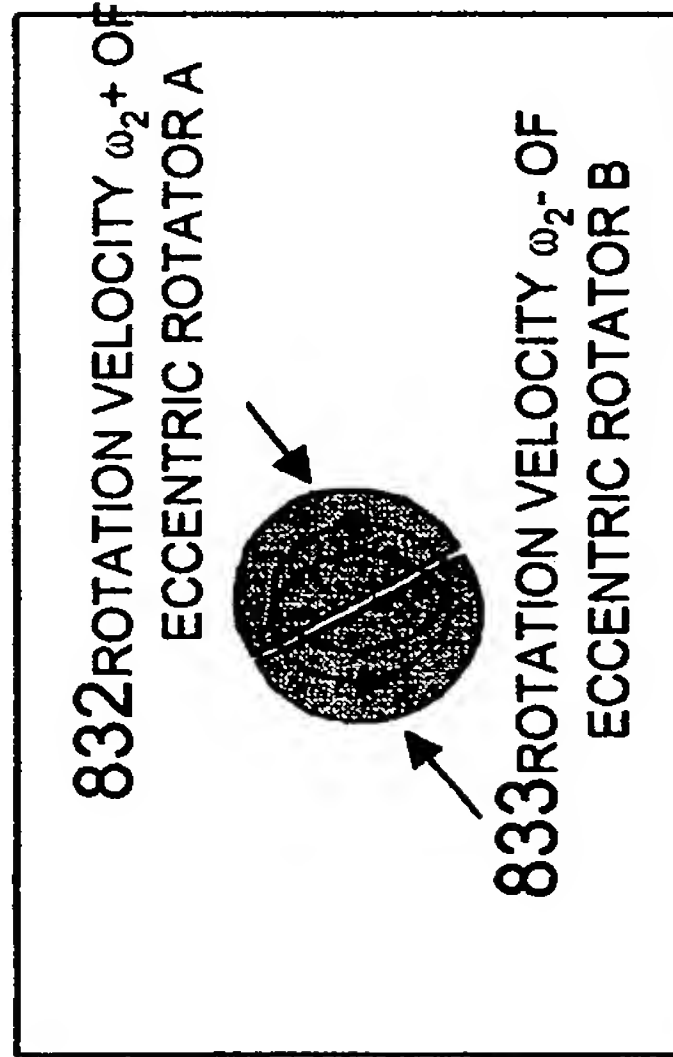


FIG. 1 1-1



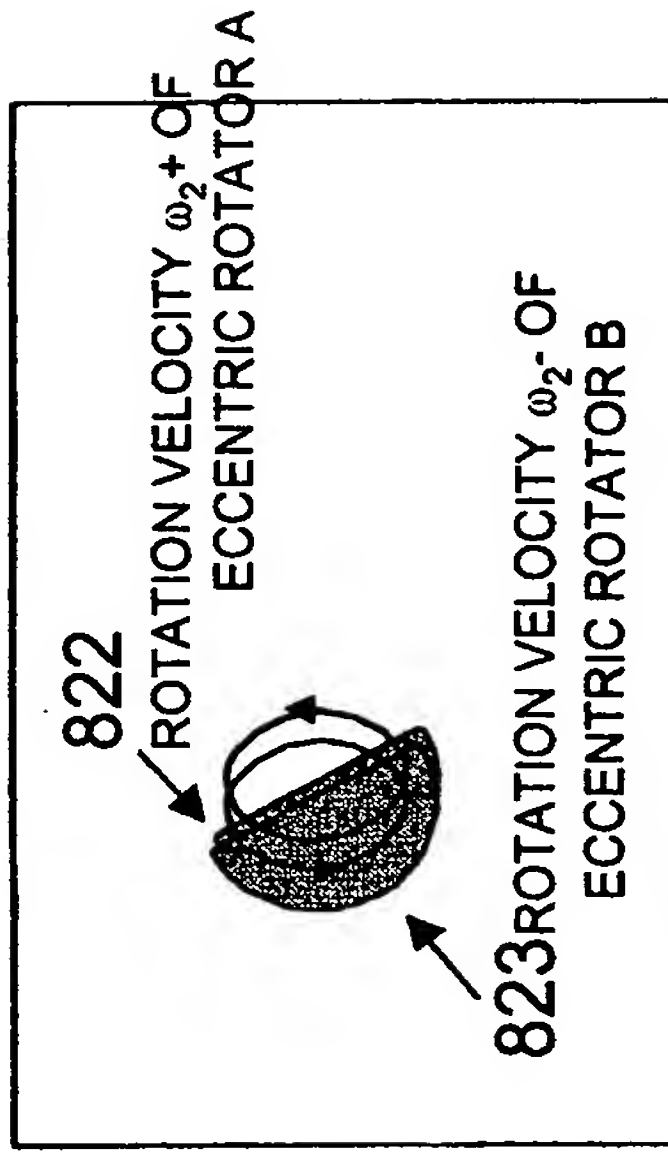
811 TWIN ECCENTRIC ROTATOR

FIG. 1 1-2



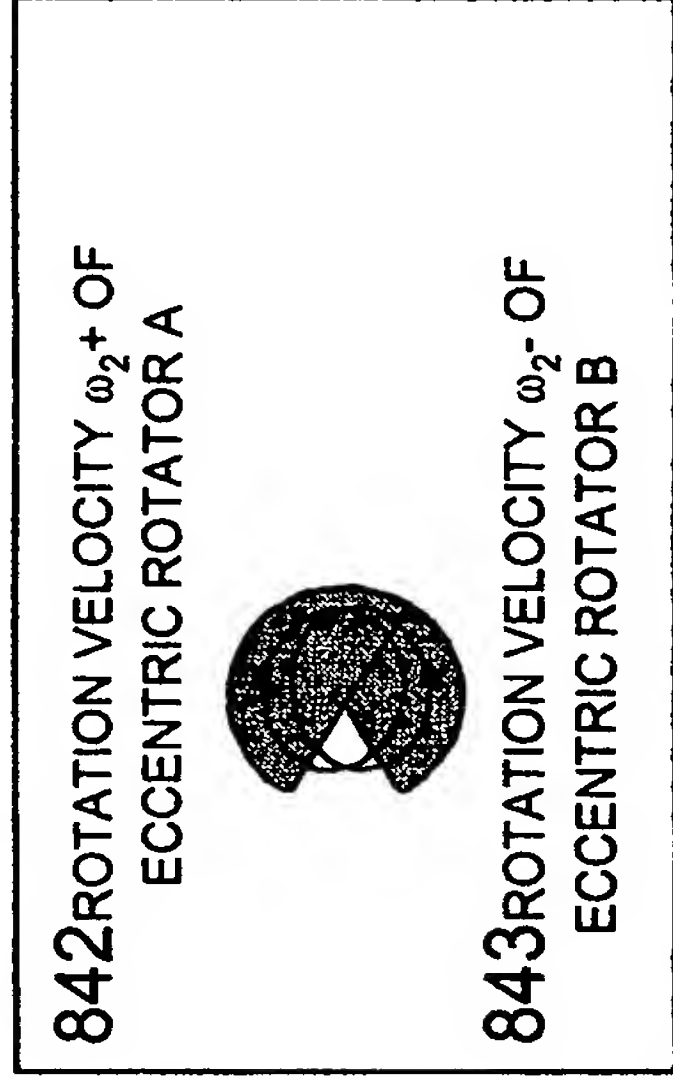
831 PHASE RELATION OF TWIN ECCENTRIC ROTATOR FOR TORQUE PRESENTATION

FIG. 1 1-3



821 PHASE RELATION OF TWIN ECCENTRIC ROTATOR FOR VIBRATION PRESENTATION

FIG. 1 1-4



841 PHASE RELATION OF TWIN ECCENTRIC ROTATOR FOR FORCE PRESENTATION

FIG. 1 2-1

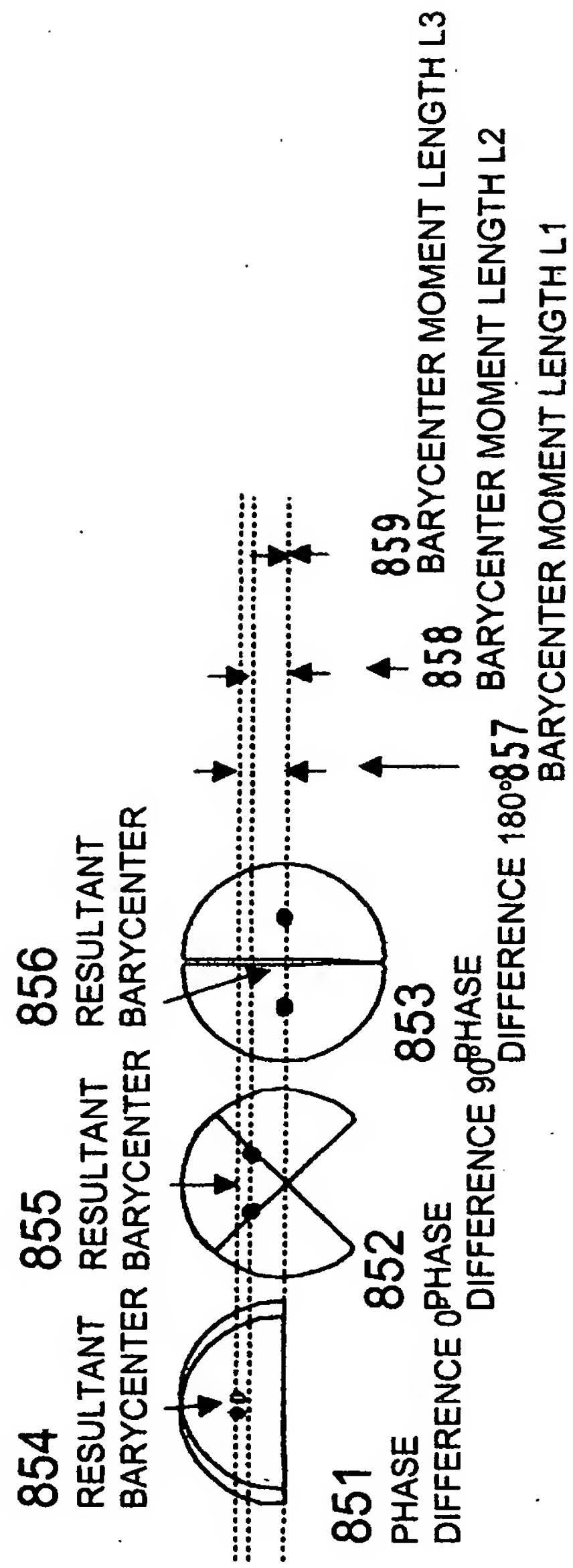


FIG. 1 2-2

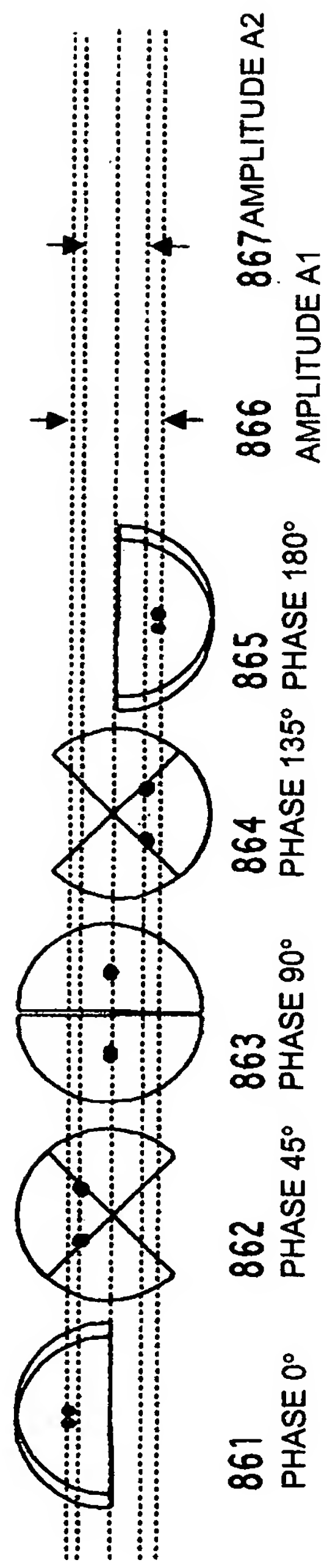


FIG. 1 3

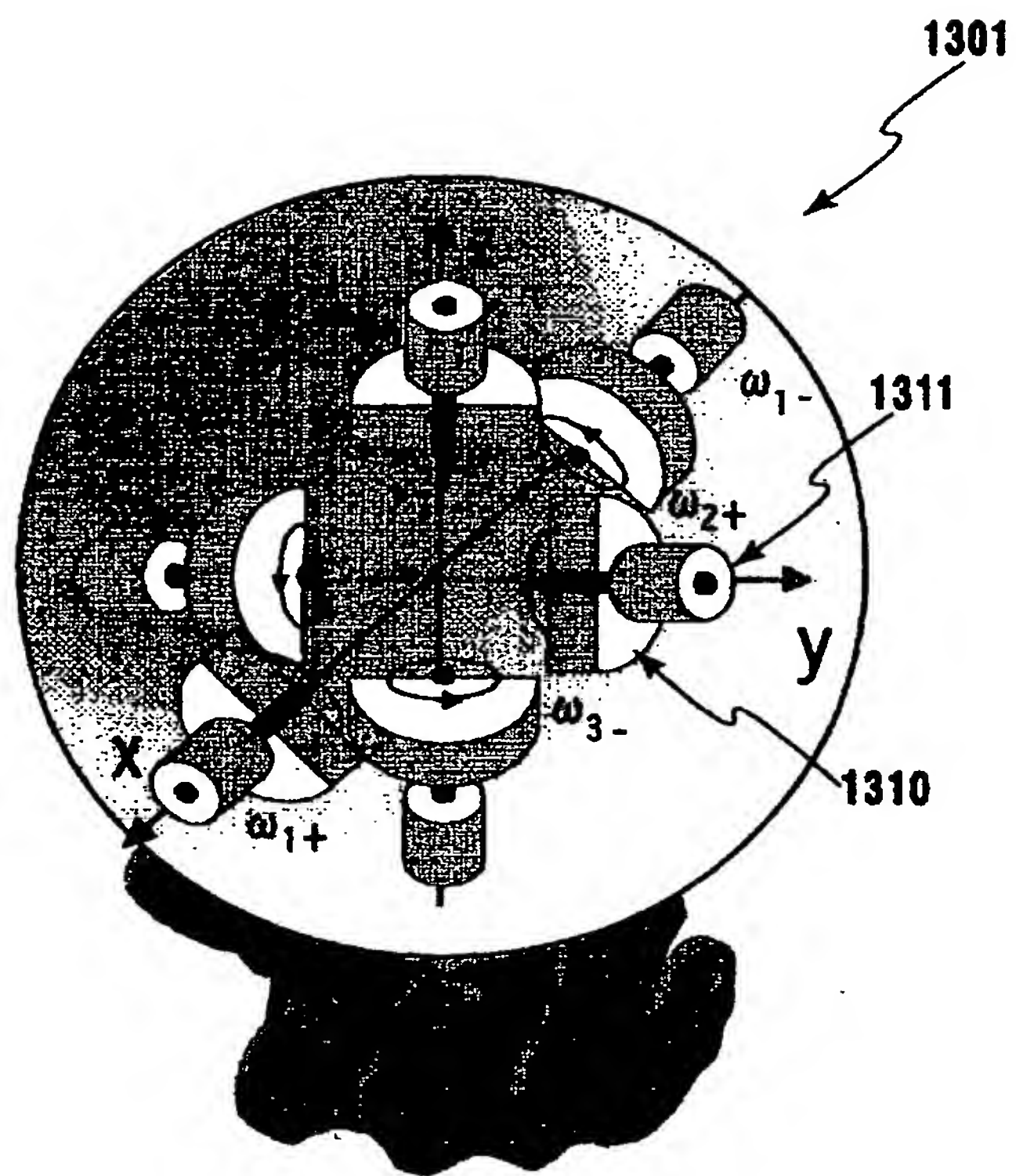


FIG. 1 4

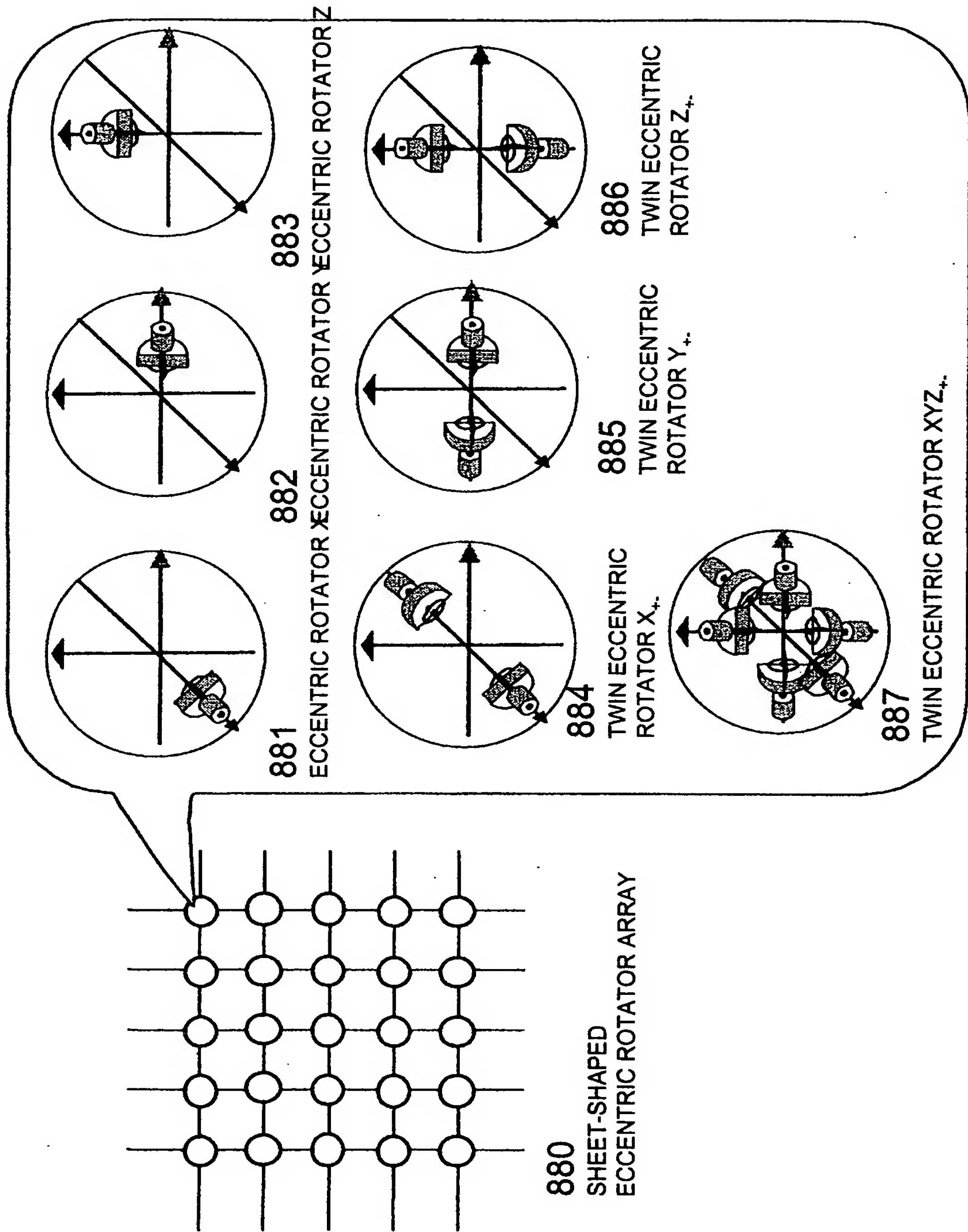


FIG. 1 5

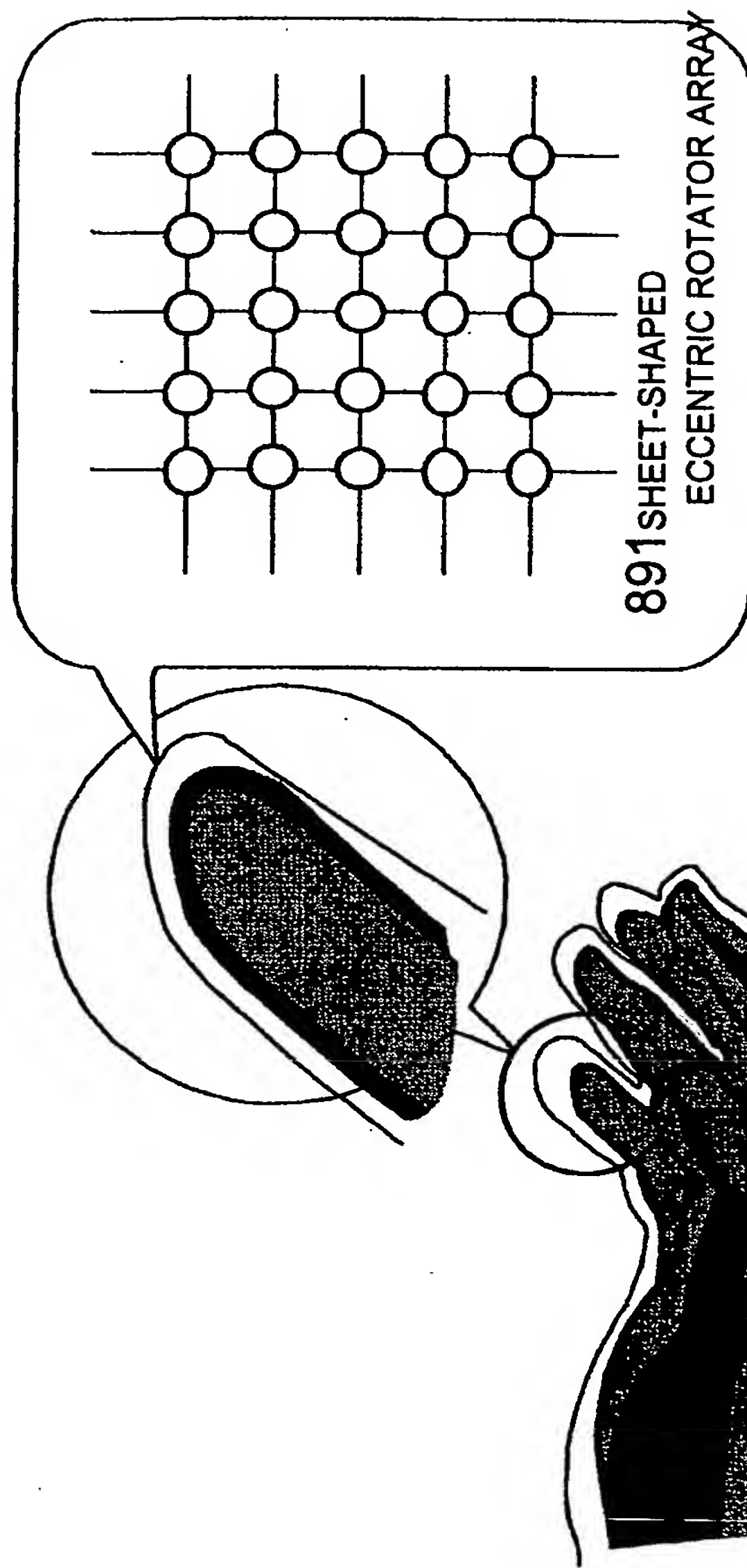
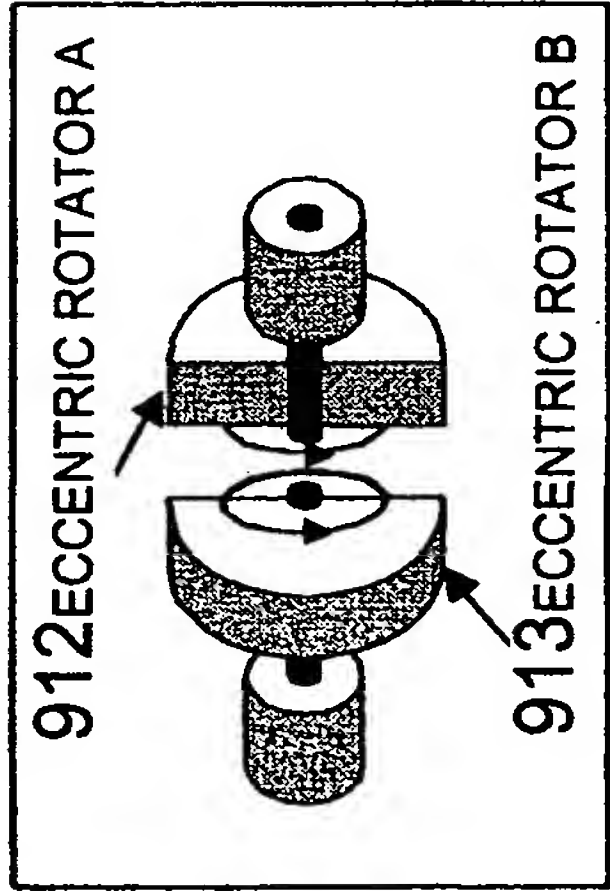
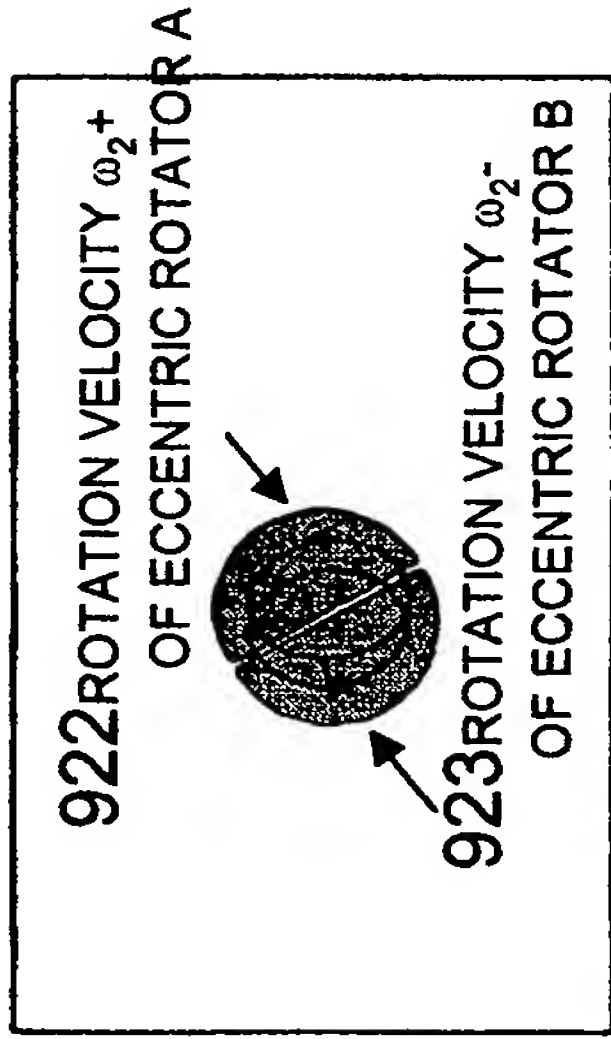


FIG. 1 6 - 1



911 TWIN ECCENTRIC ROTATOR

FIG. 1 6 - 2



921 PHASE RELATION OF
TWIN ECCENTRIC ROTATOR
FOR TORQUE PRESENTATION

FIG. 1 6 - 3

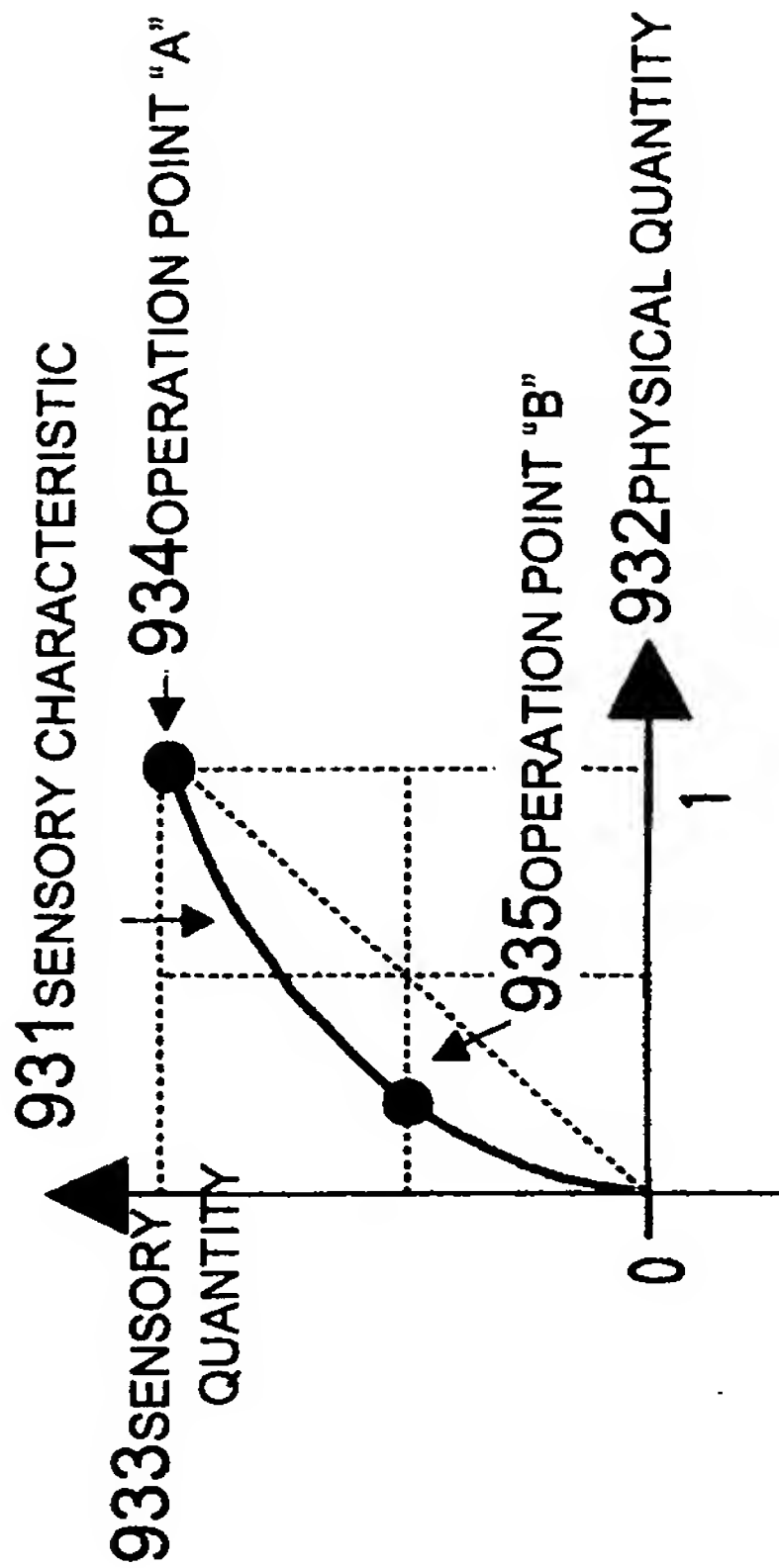


FIG. 1 6 - 4

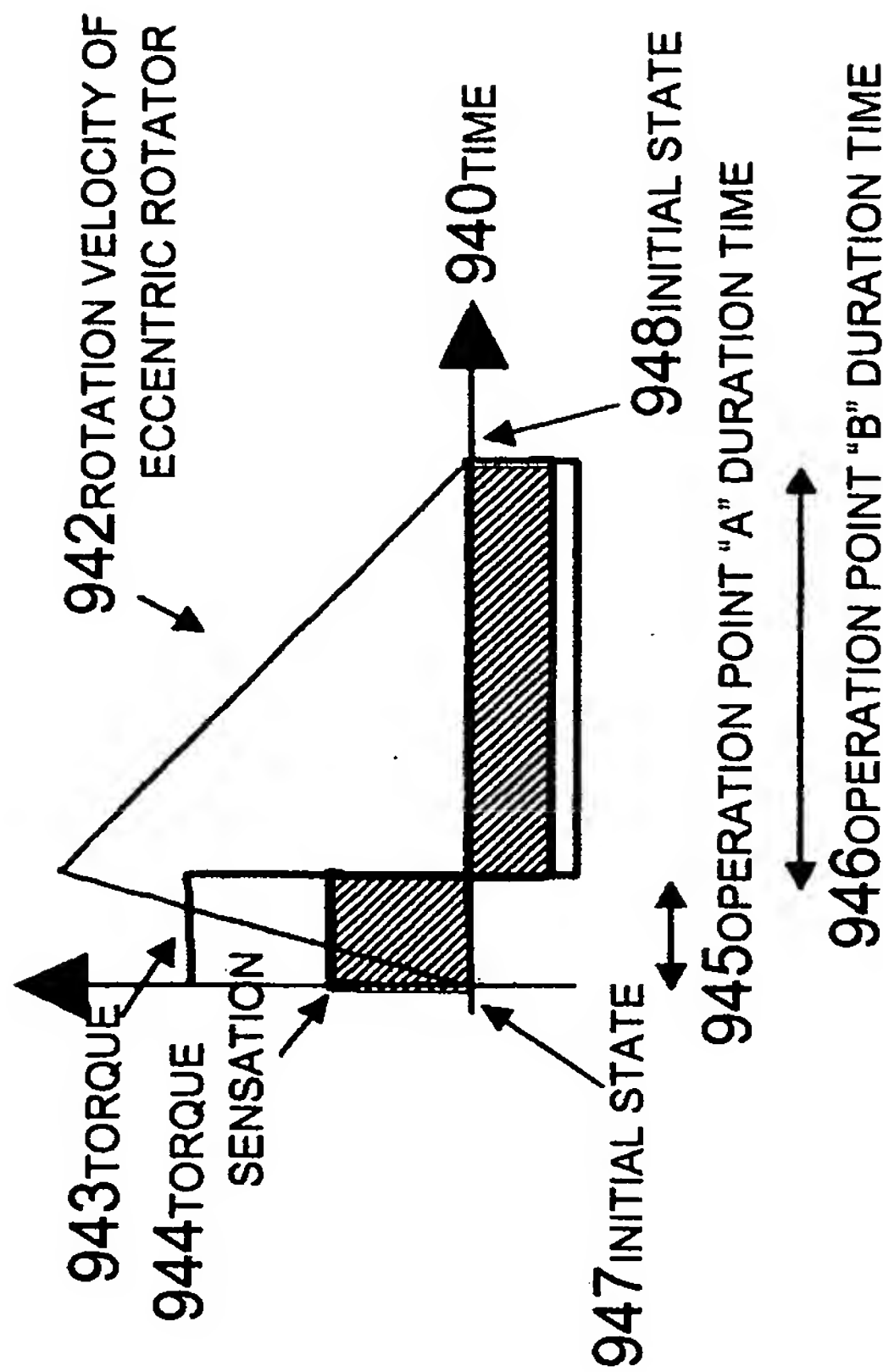
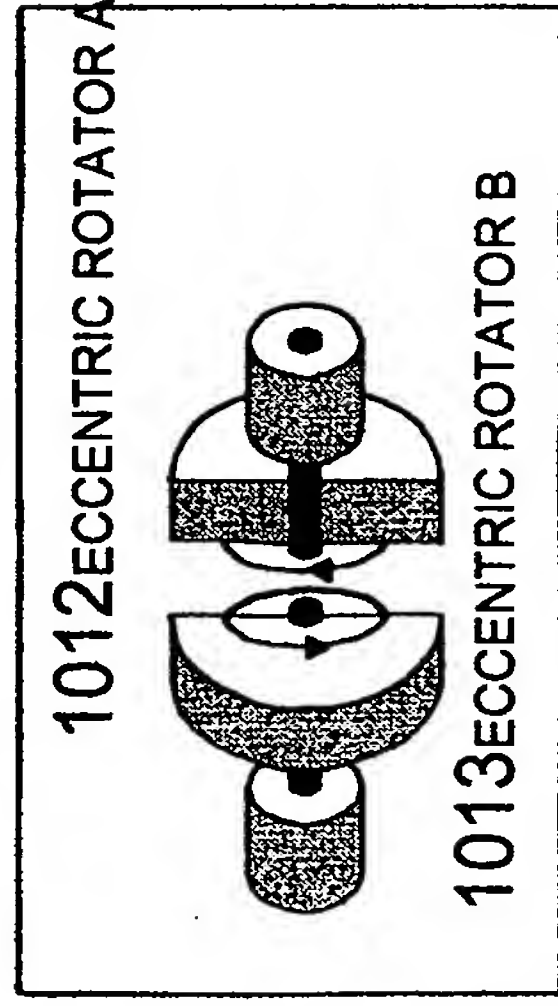
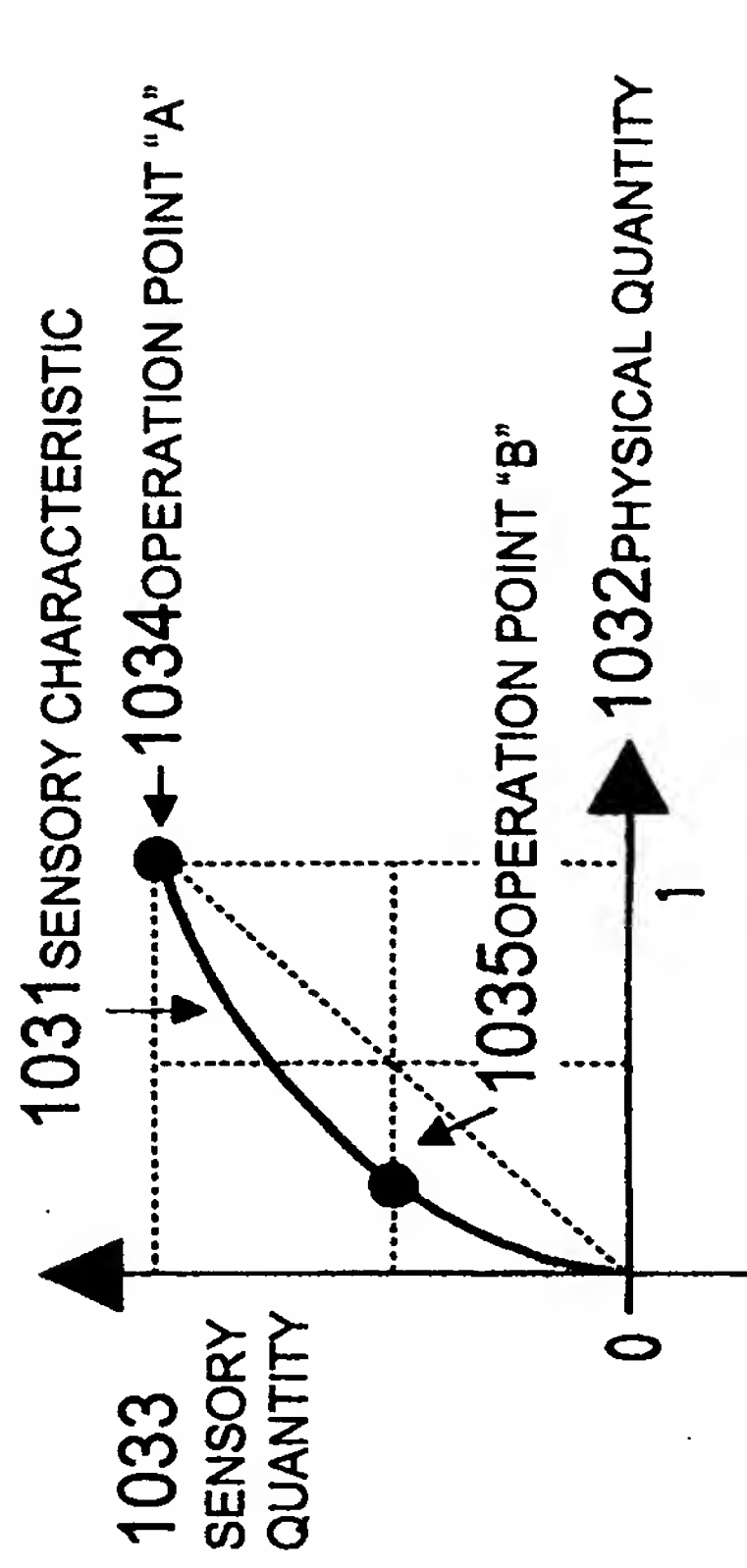


FIG. 1 7 - 1

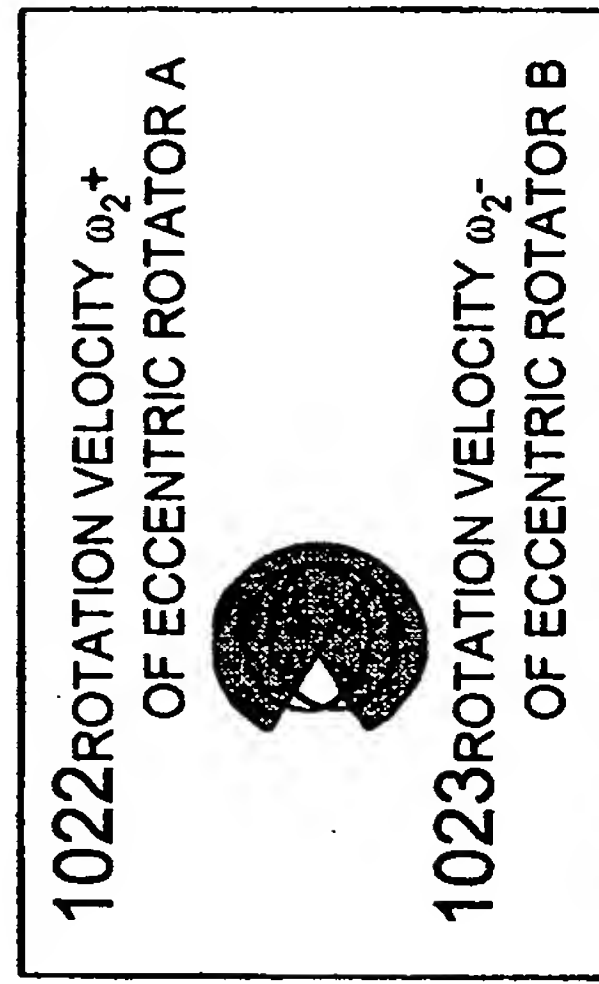
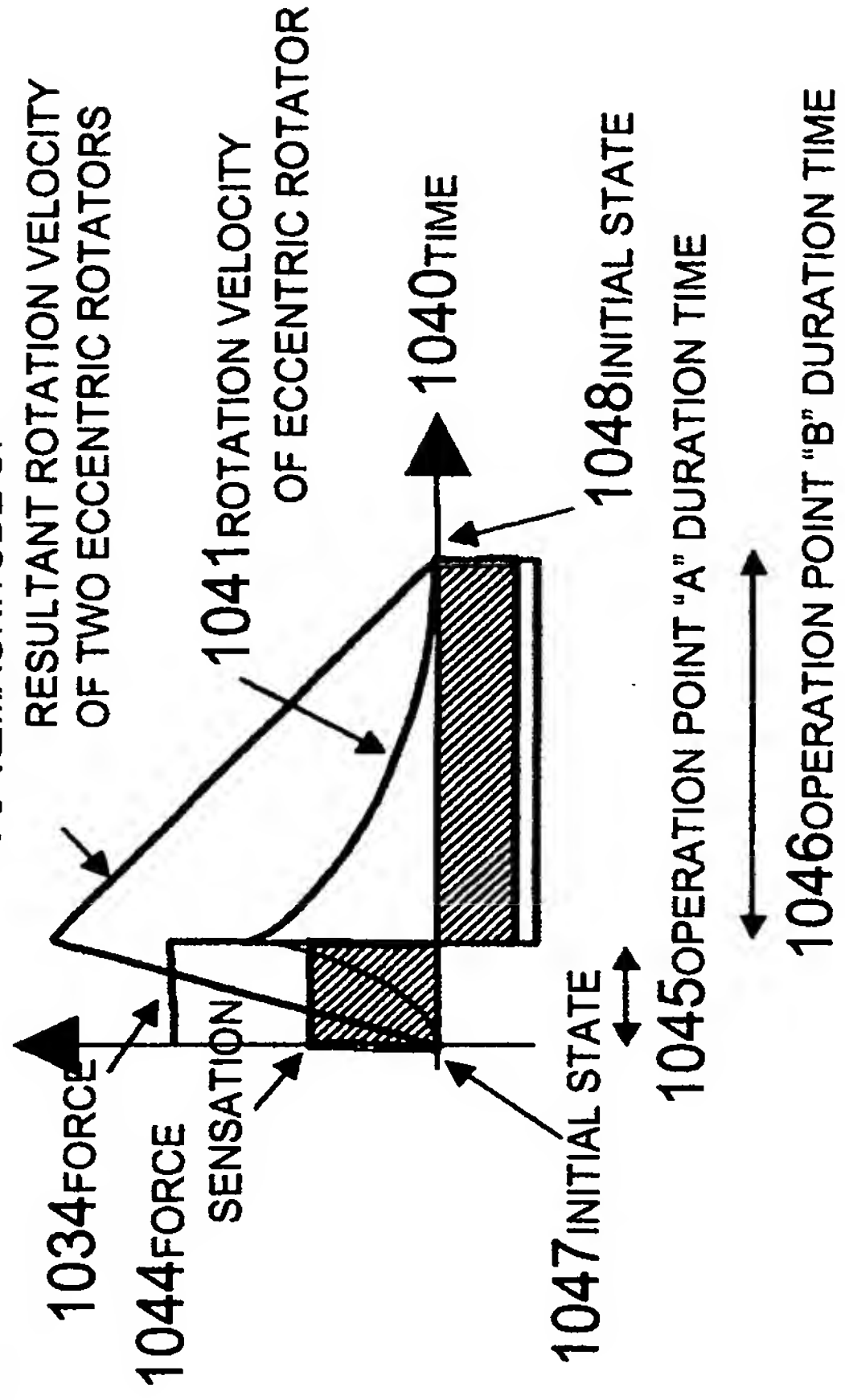
FIG. 1 7 - 3



1011 TWIN ECCENTRIC ROTATOR

FIG. 1 7 - 2

FIG. 1 7 - 4



1021 PHASE RELATION OF
TWIN ECCENTRIC ROTATOR
FOR FORCE PRESENTATION

FIG. 1 8 - 1

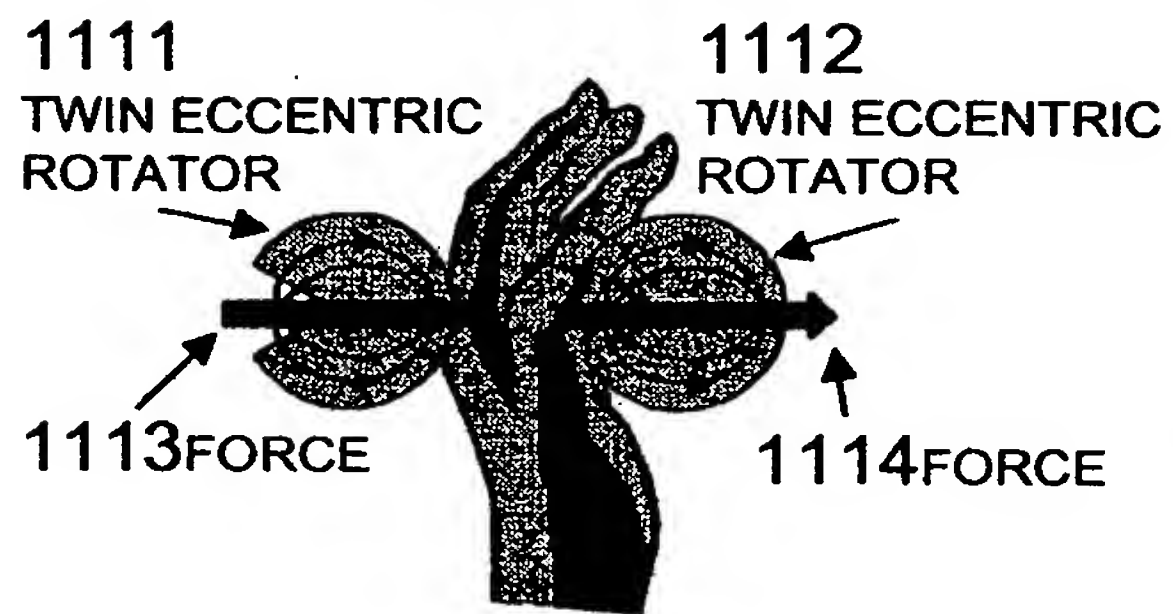


FIG. 1 8 - 2

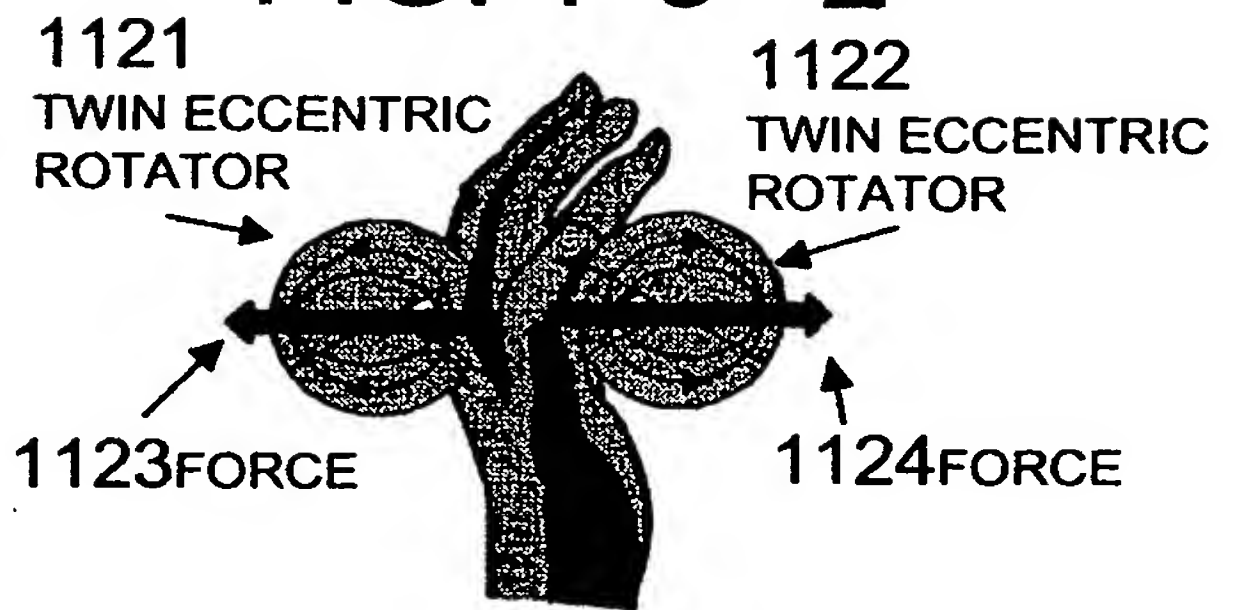


FIG. 1 8 - 3

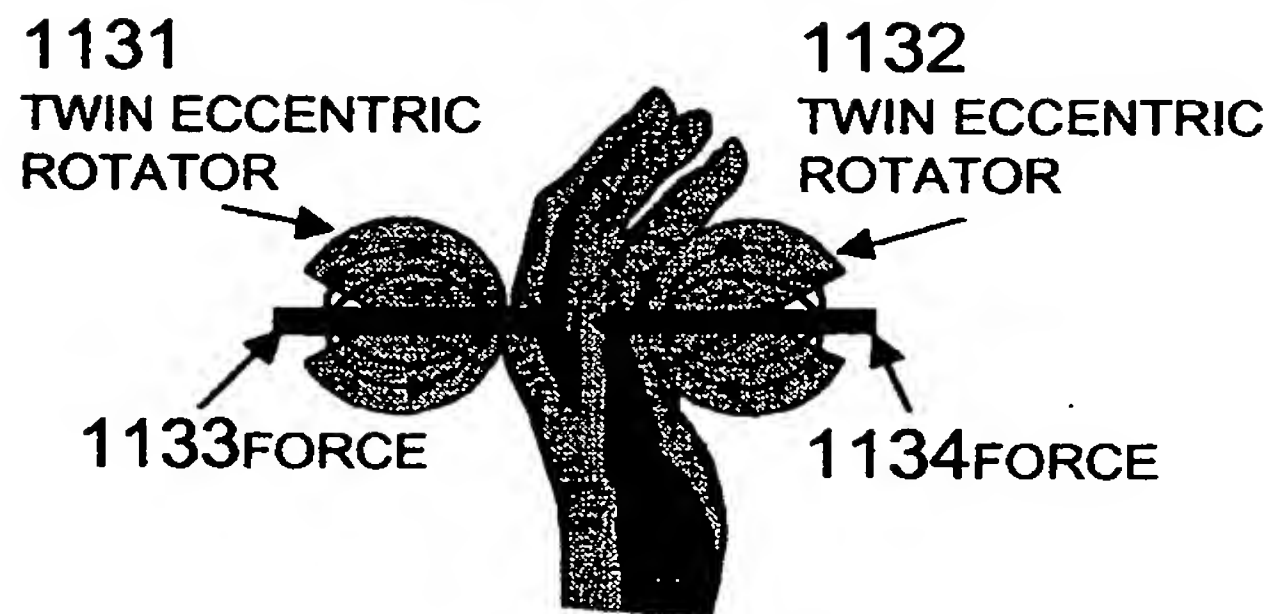


FIG. 1 8 - 4

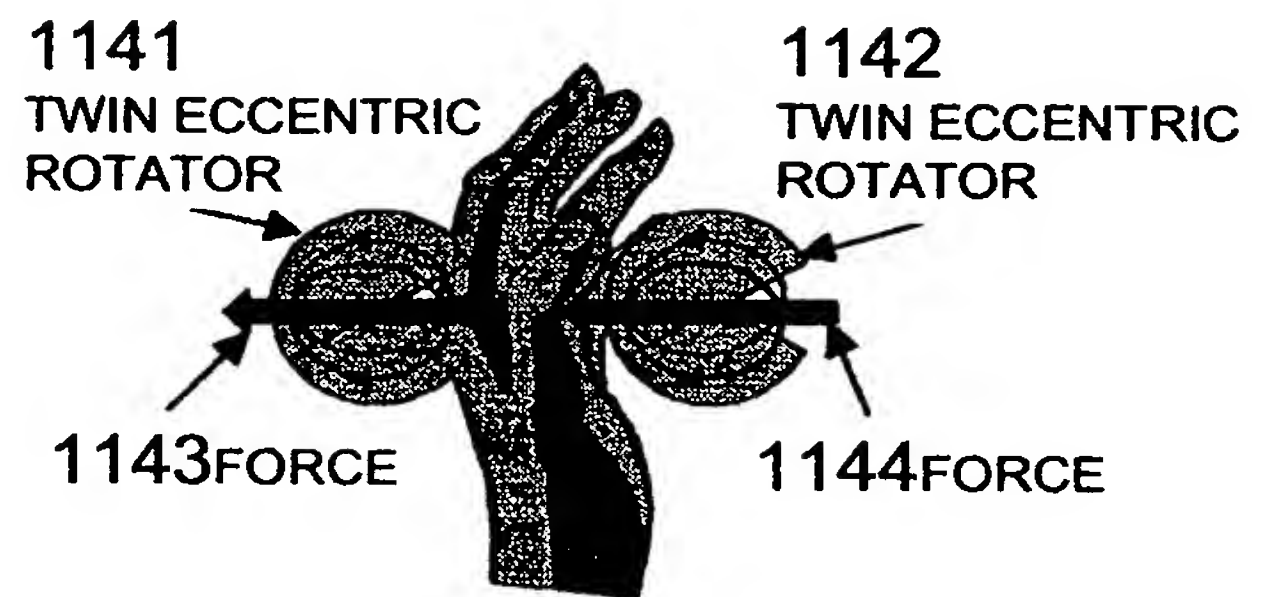


FIG. 1 8 - 5

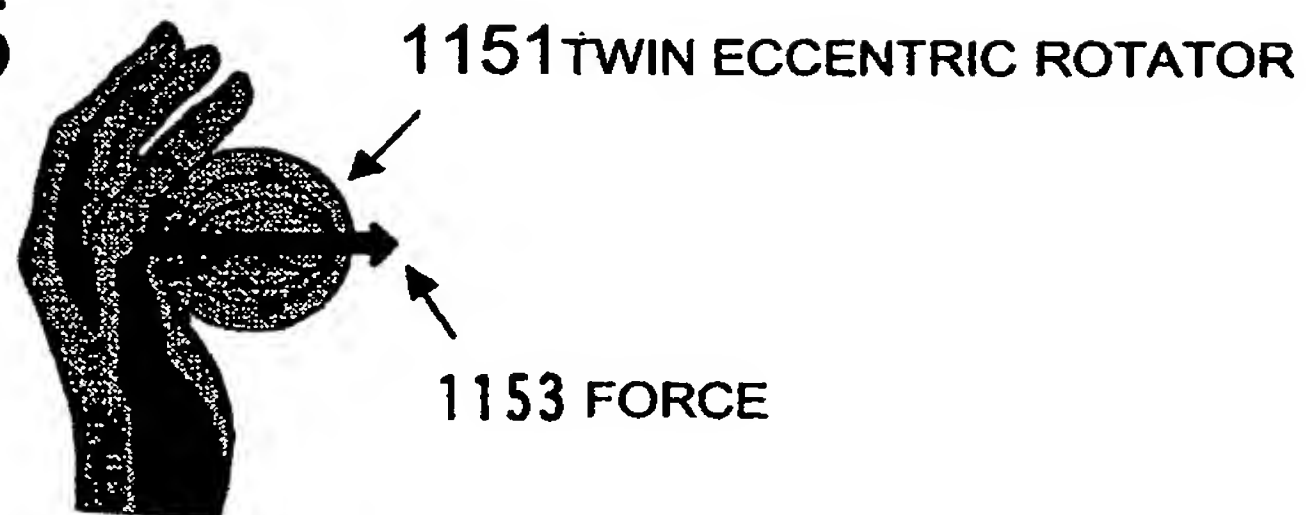


FIG. 1 8 - 5

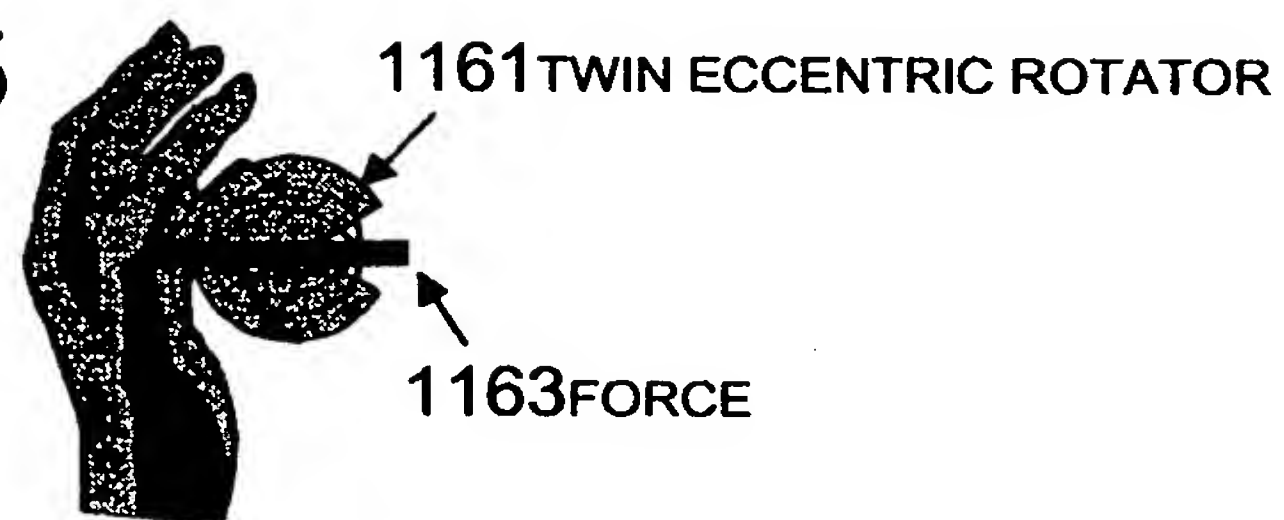


FIG. 1 9

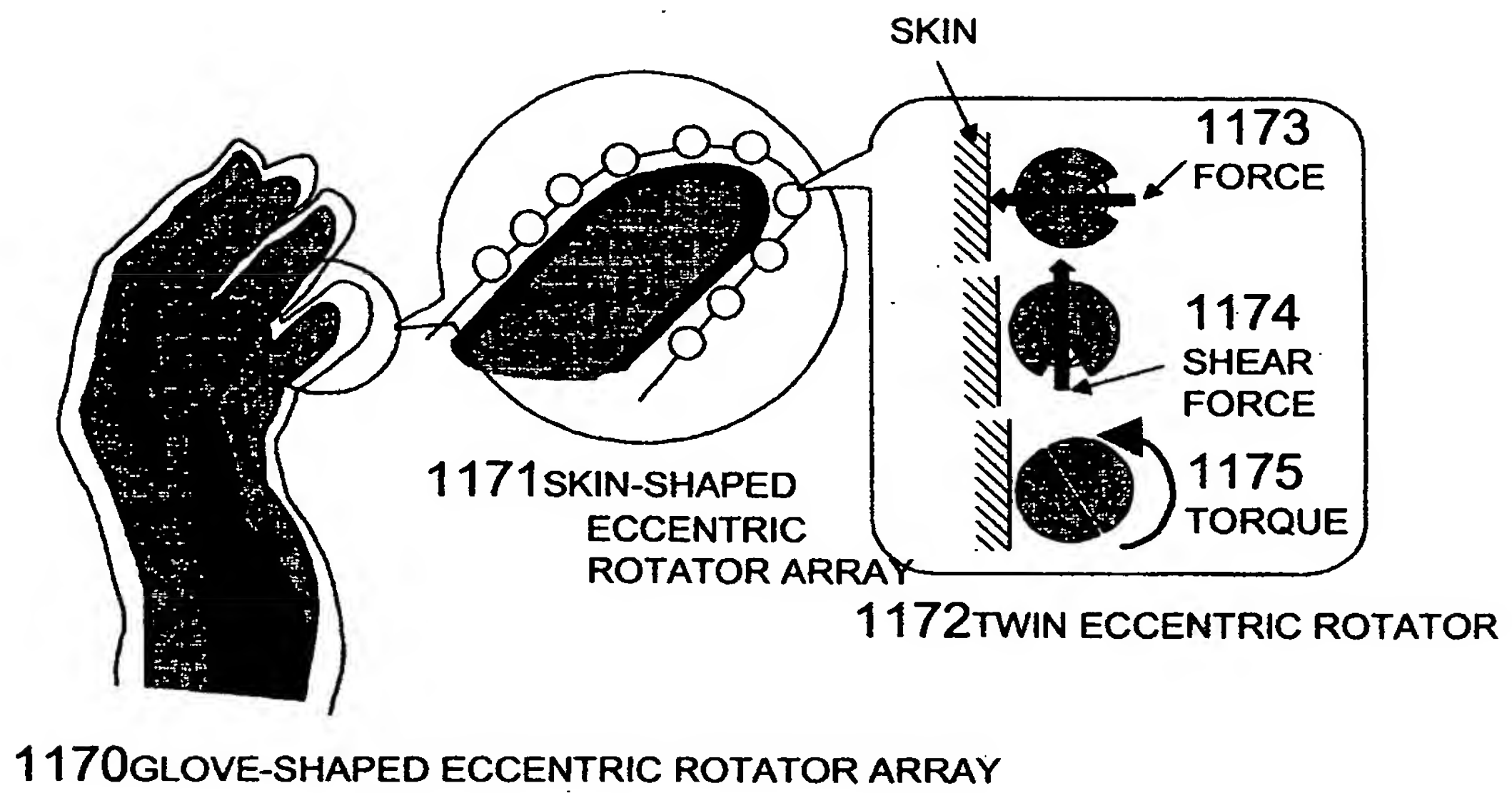


FIG. 2 0

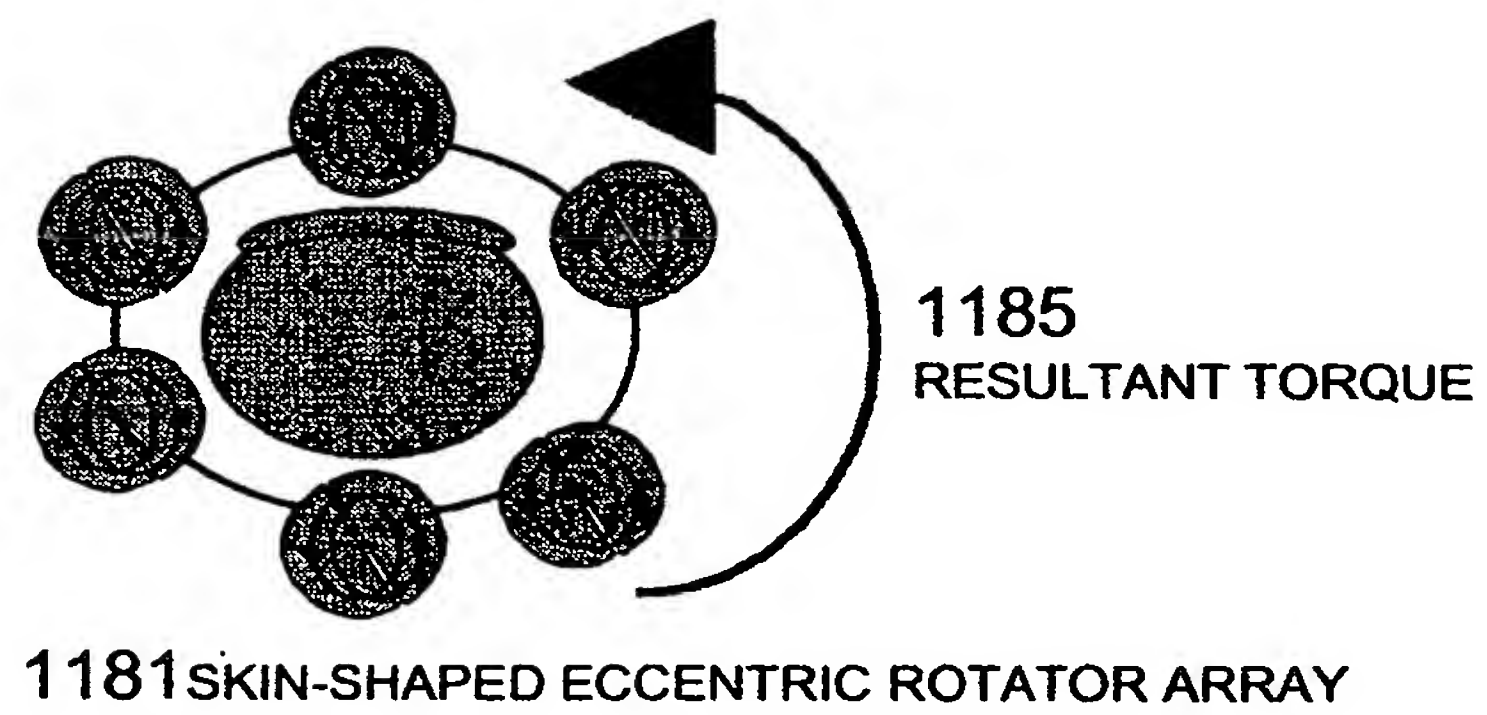


FIG. 2 1

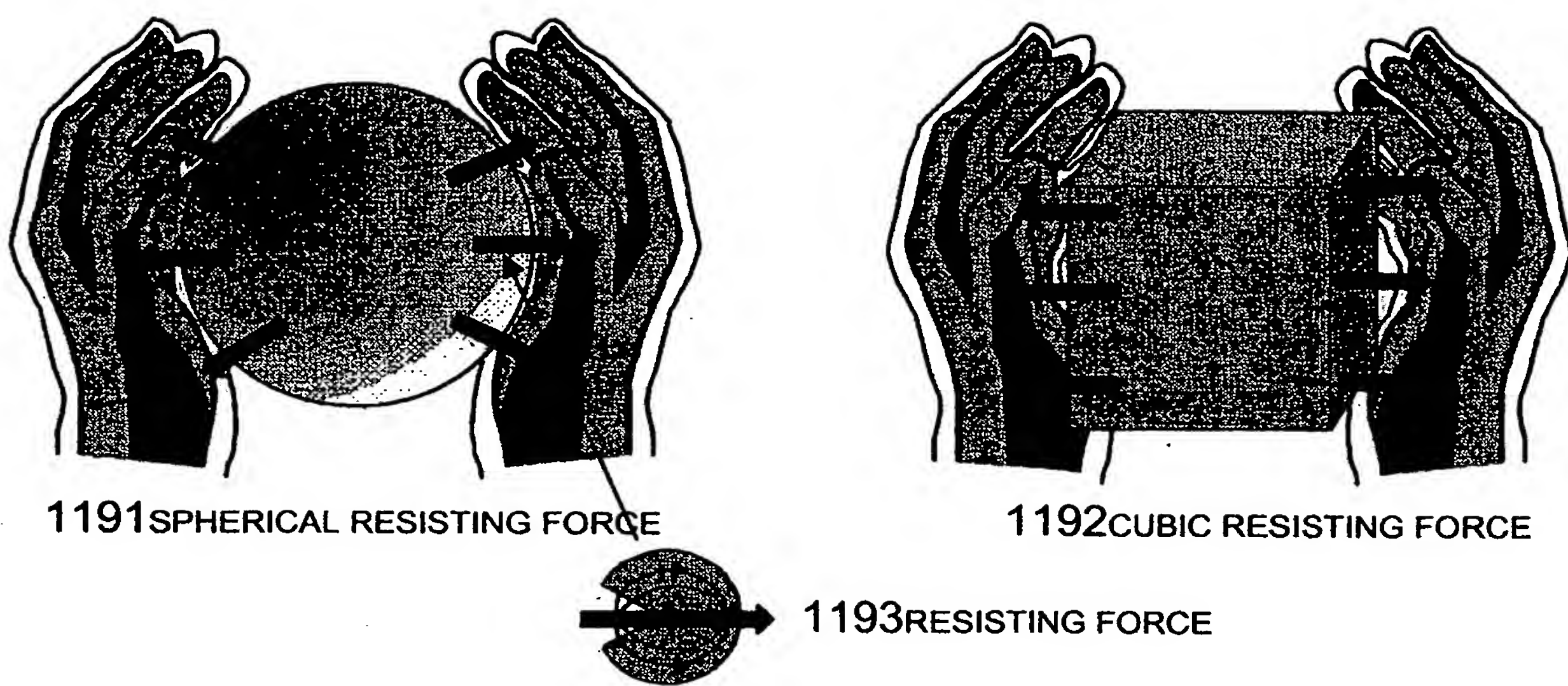


FIG. 2 2

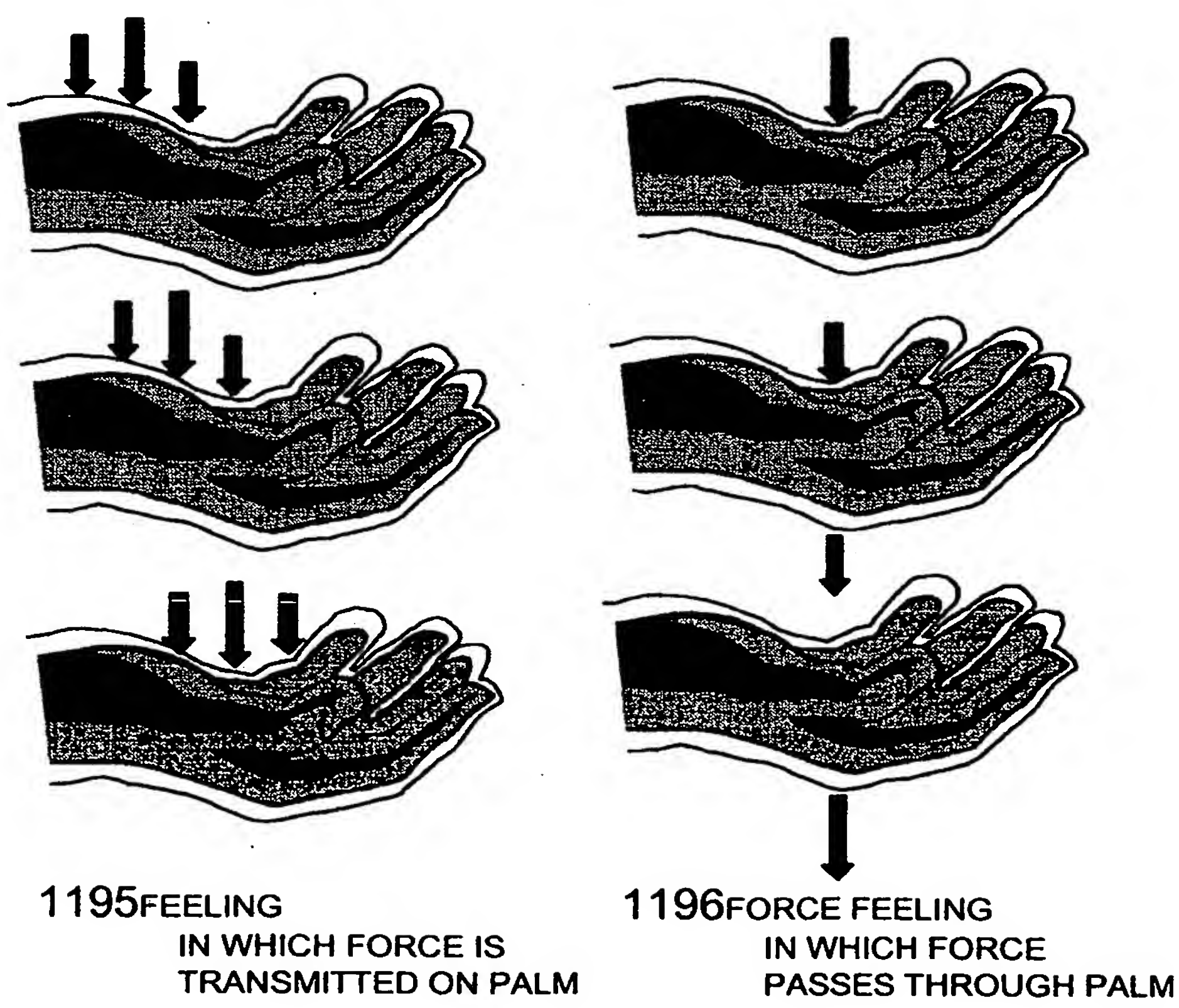


FIG. 2 3 - 1

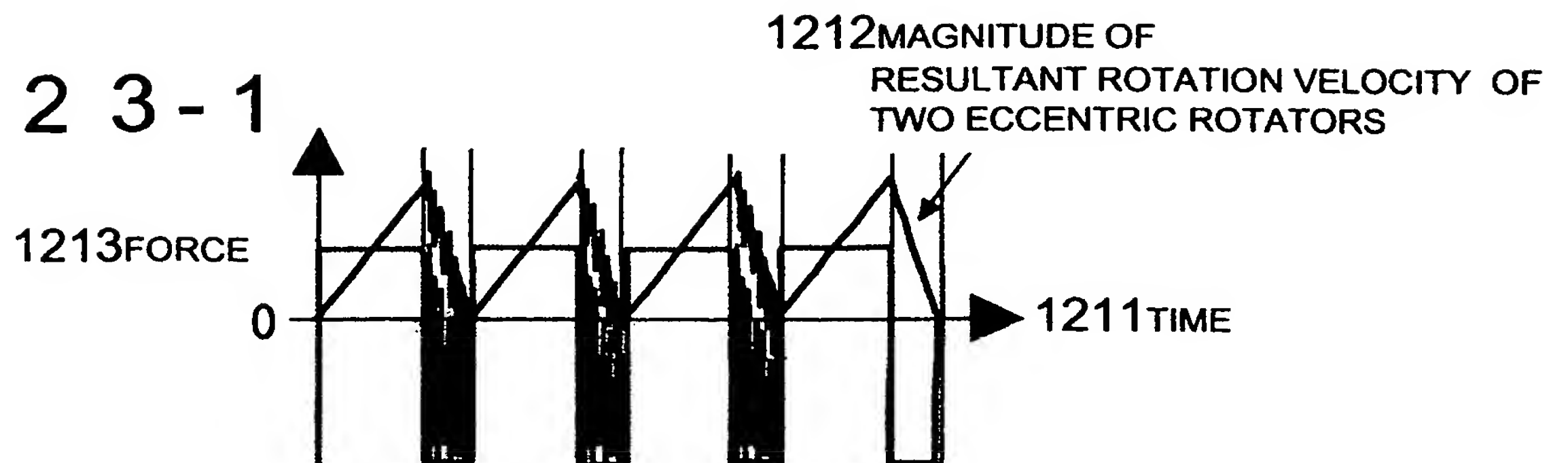


FIG. 2 3 - 2

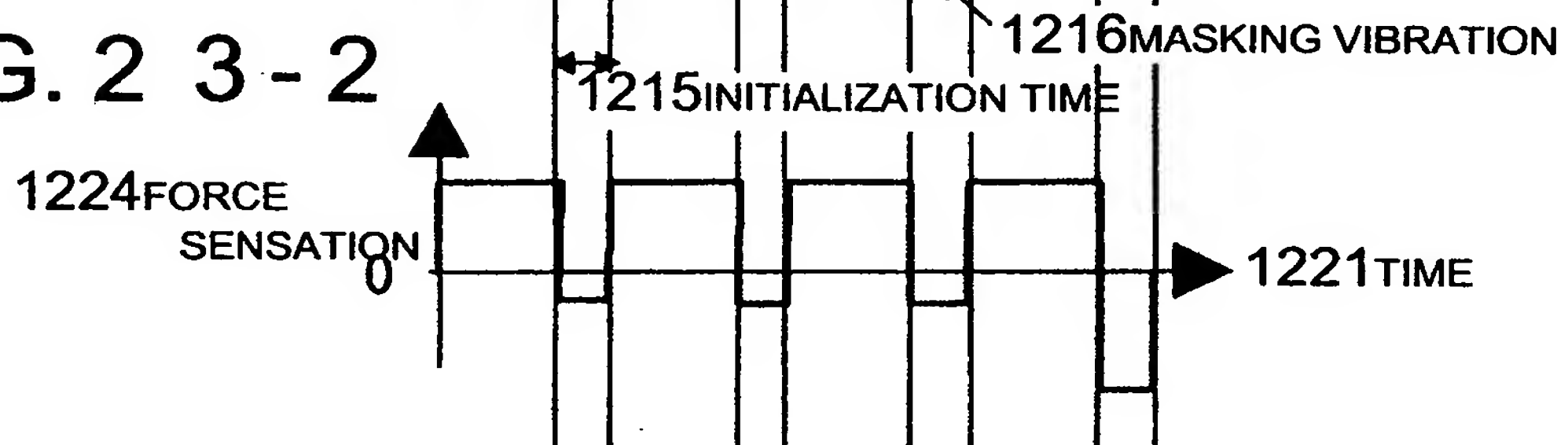


FIG. 2 3 - 3

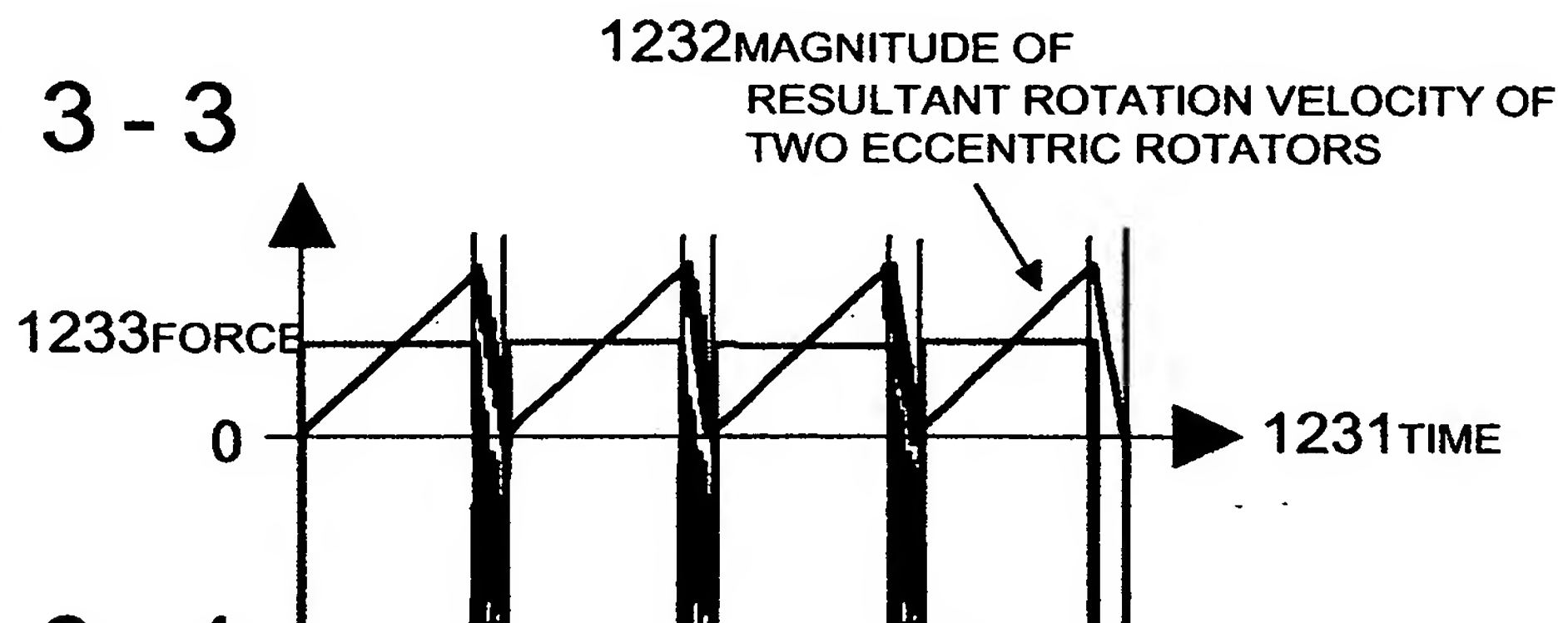


FIG. 2 3 - 4

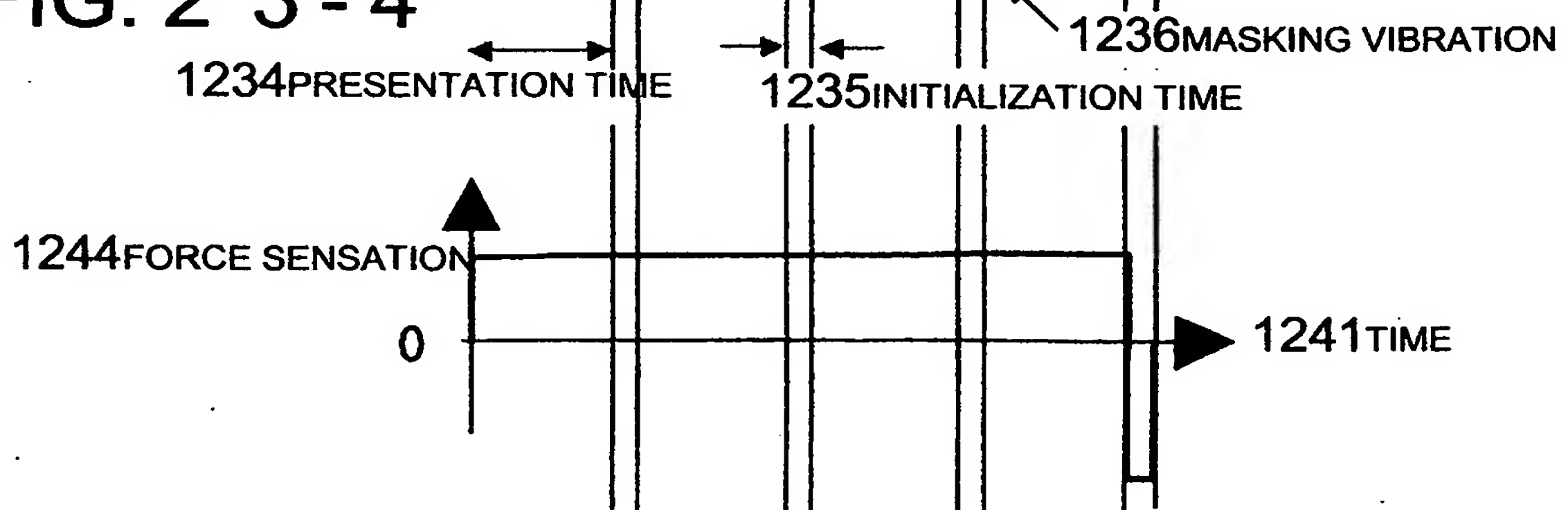
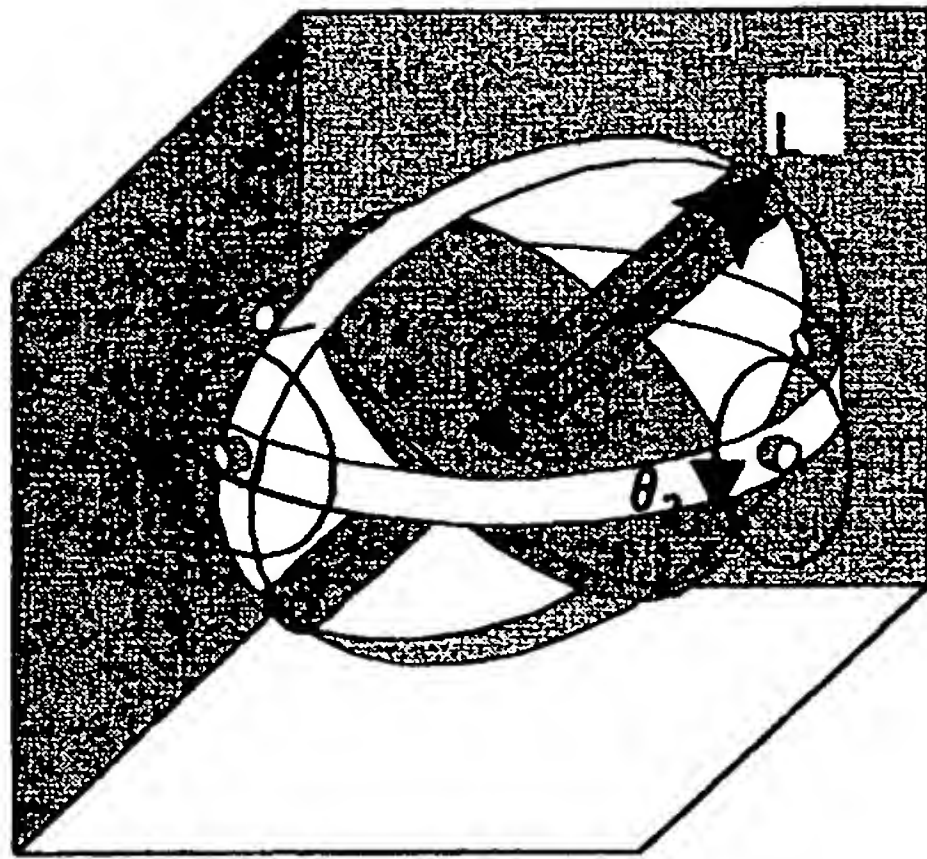
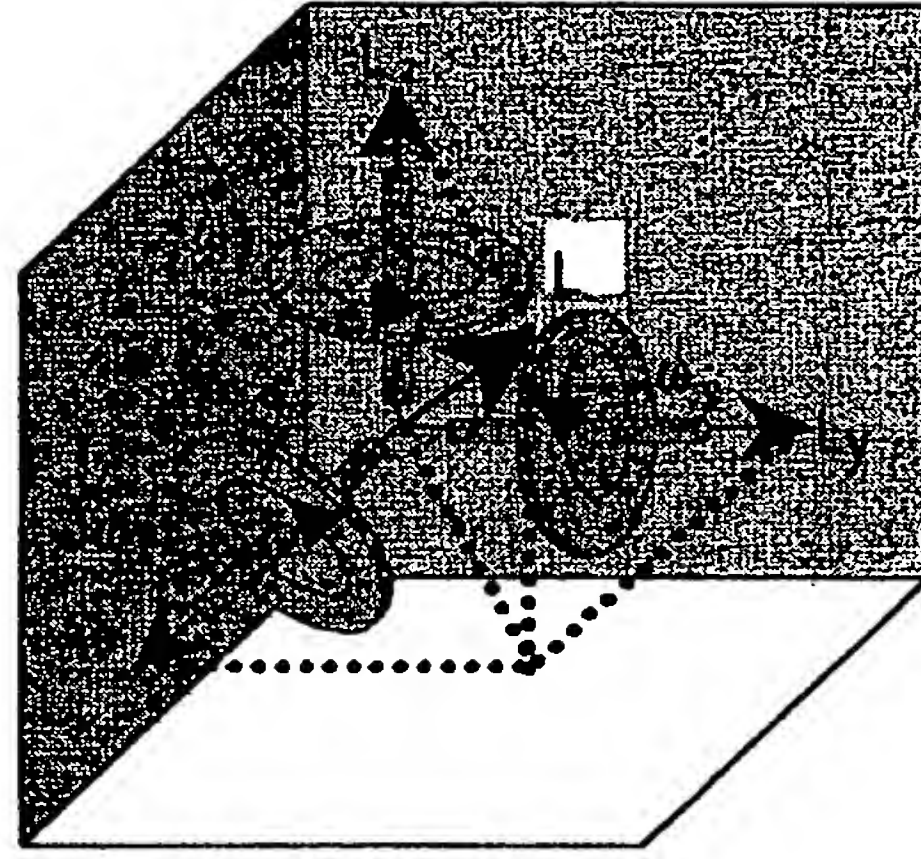


FIG. 2 4 - 1



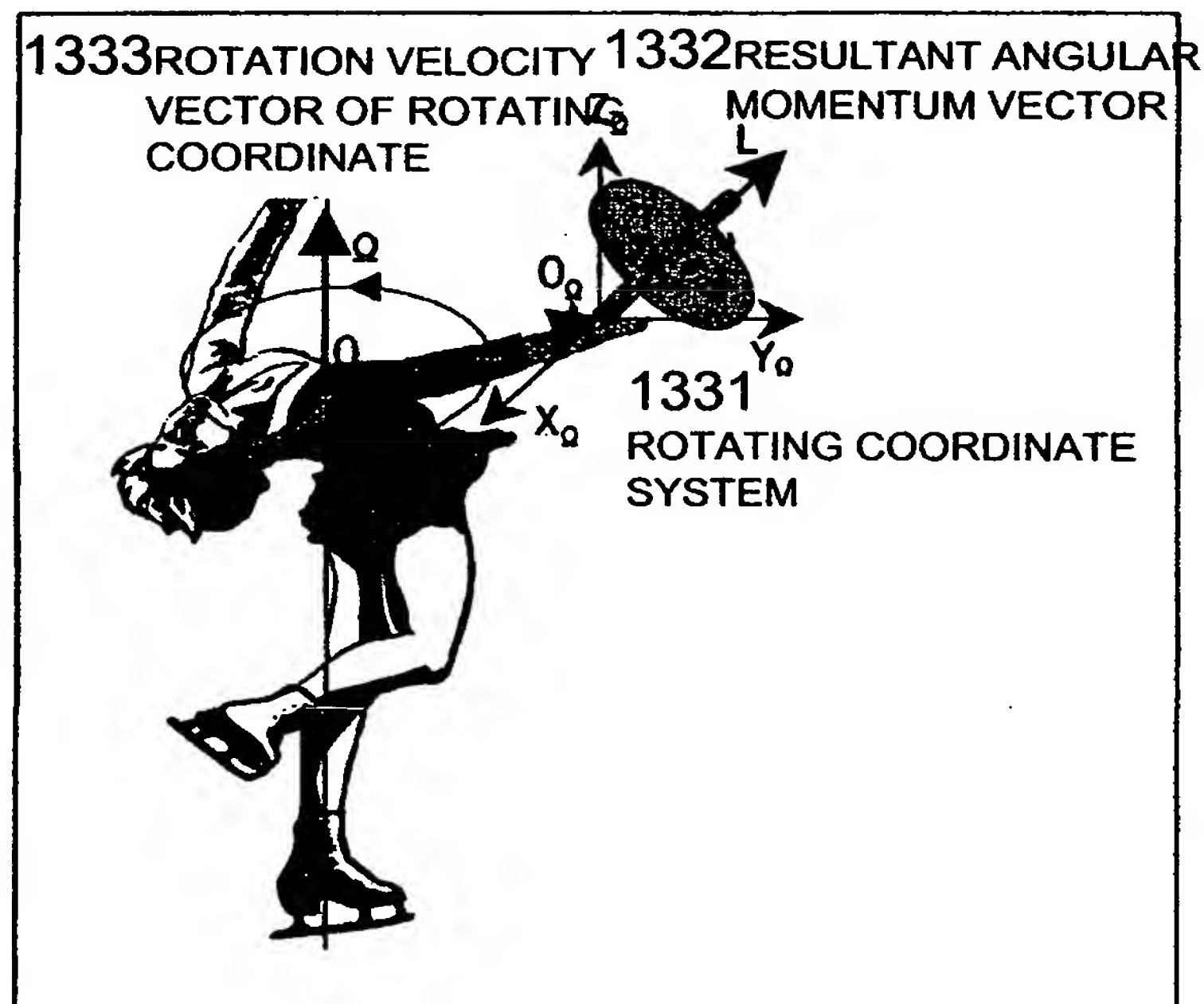
1311GYROSCOPE TYPE

FIG. 2 4 - 2



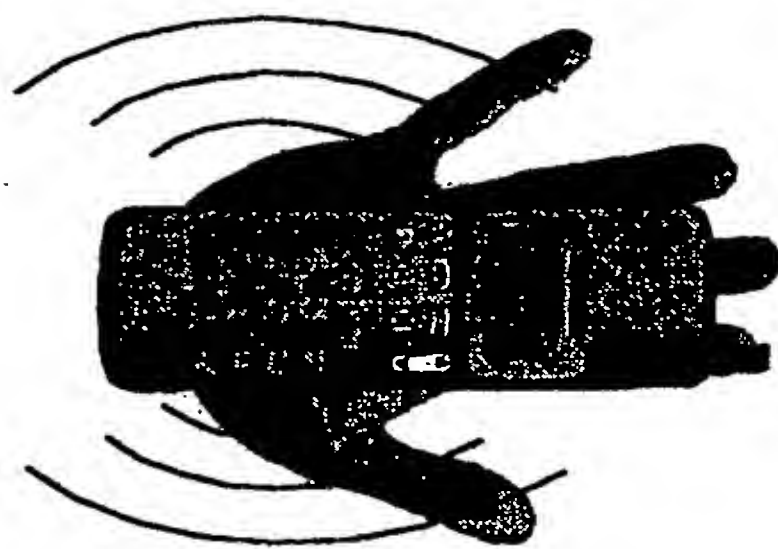
1312RESULTANT ANGULAR MOMENTUM
VECTOR DIFFERENTIAL TYPE

FIG. 2 5



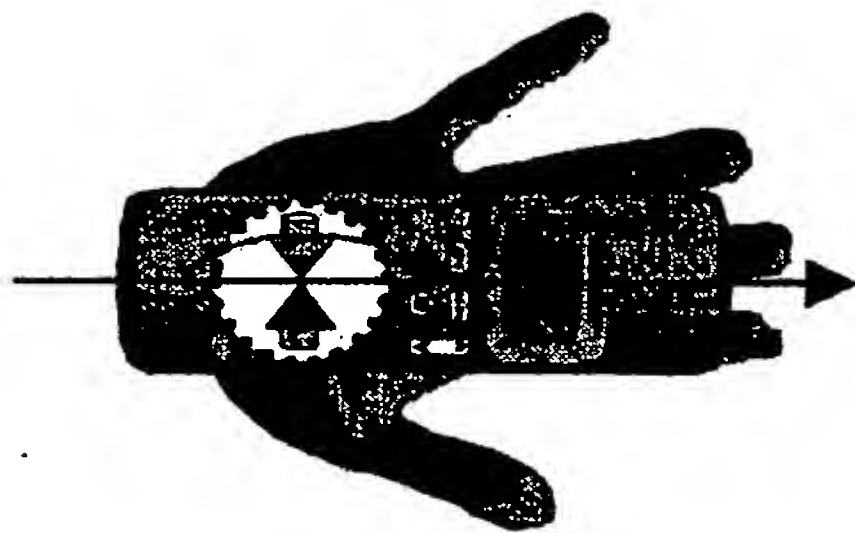
1330INERTIA COORDINATE SYSTEM

FIG. 2 6 - 1



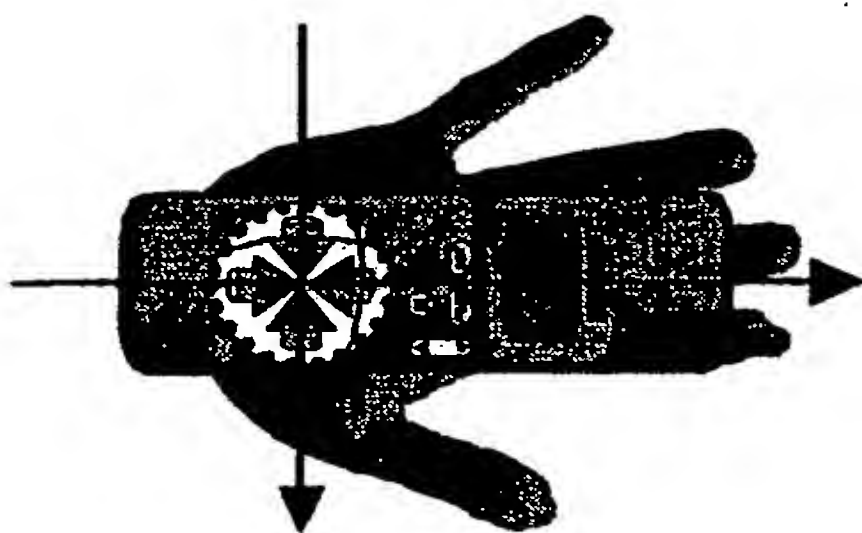
1341 VIBRATION

FIG. 2 6 - 2



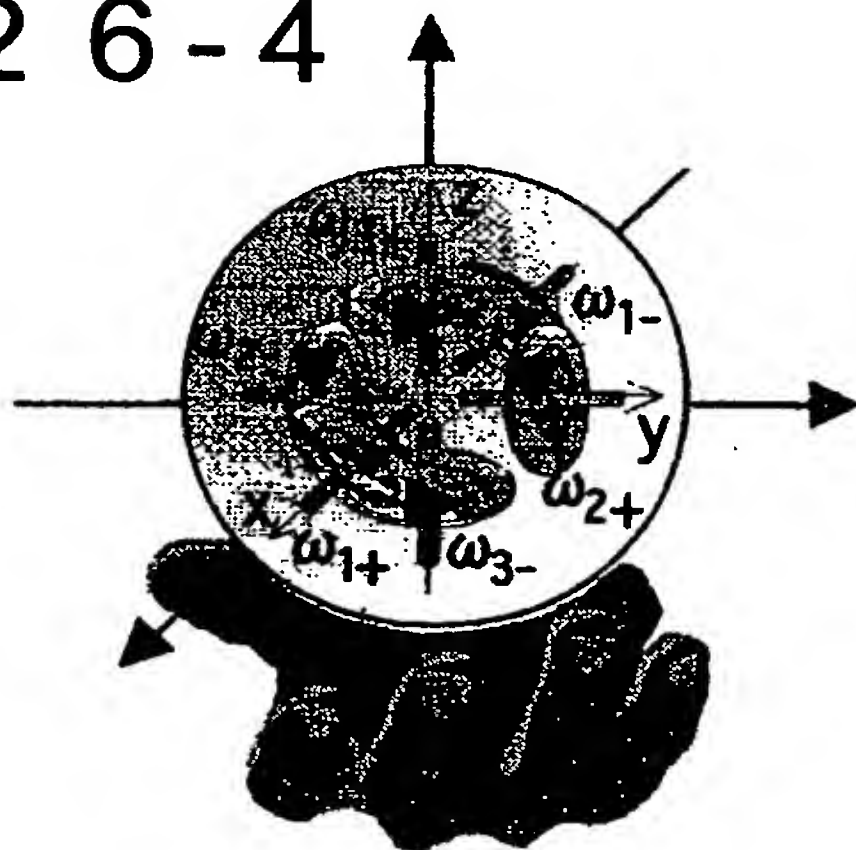
1342 ONE-DIMENSIONAL
TORQUE PRESENTATION

FIG. 2 6 - 3



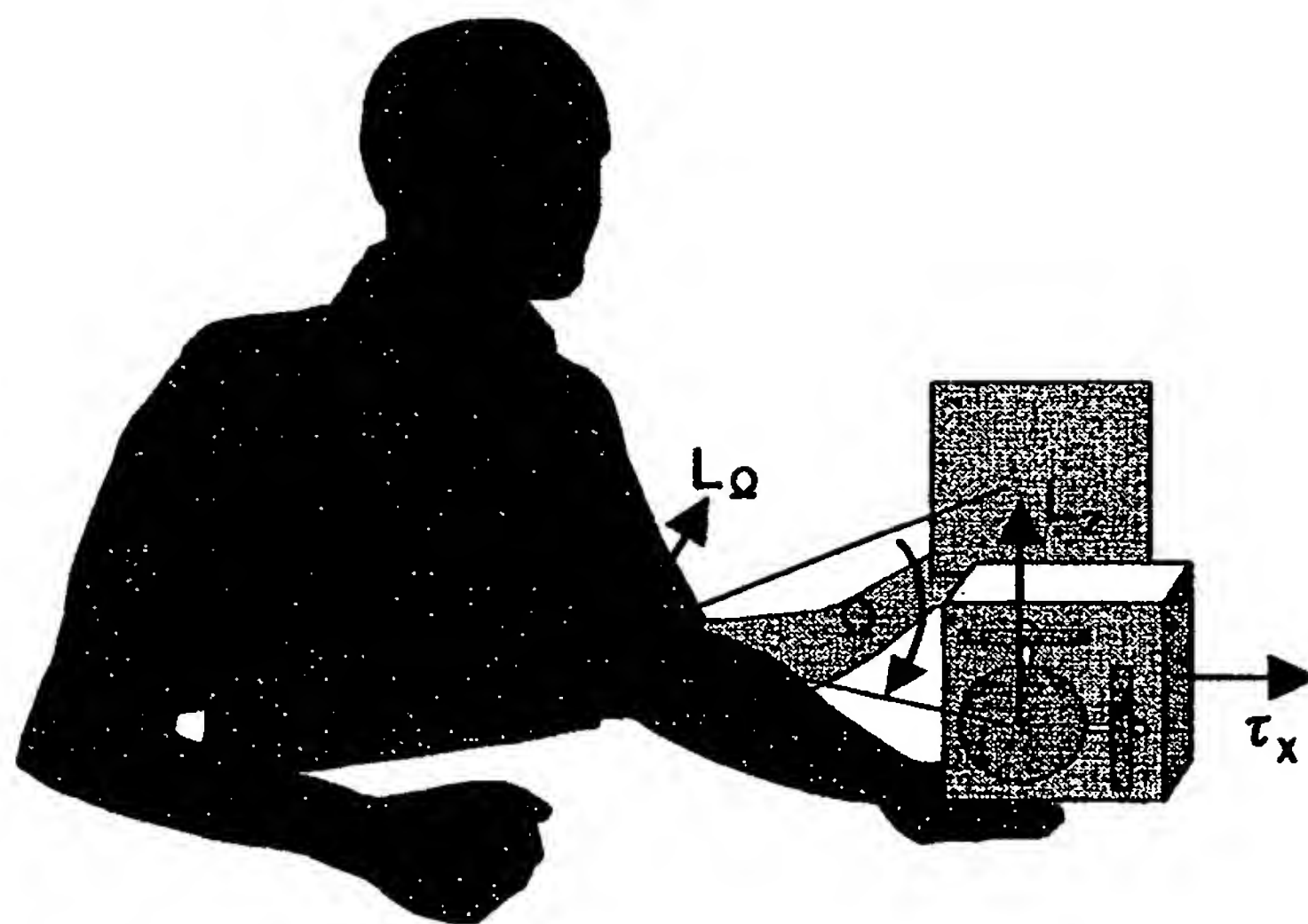
1343 TWO-DIMENSIONAL
TORQUE PRESENTATION

FIG. 2 6 - 4



1344 THREE-DIMENSIONAL
TORQUE PRESENTATION

FIG. 2 7



1351 STABILIZER

FIG. 2 8

TWO-DIMENSIONAL SECTIONAL VIEW OF HAPTIC PRESENTATION DEVICE
(EXPANSION MAY BE MADE TO THREE DIMENSIONS)

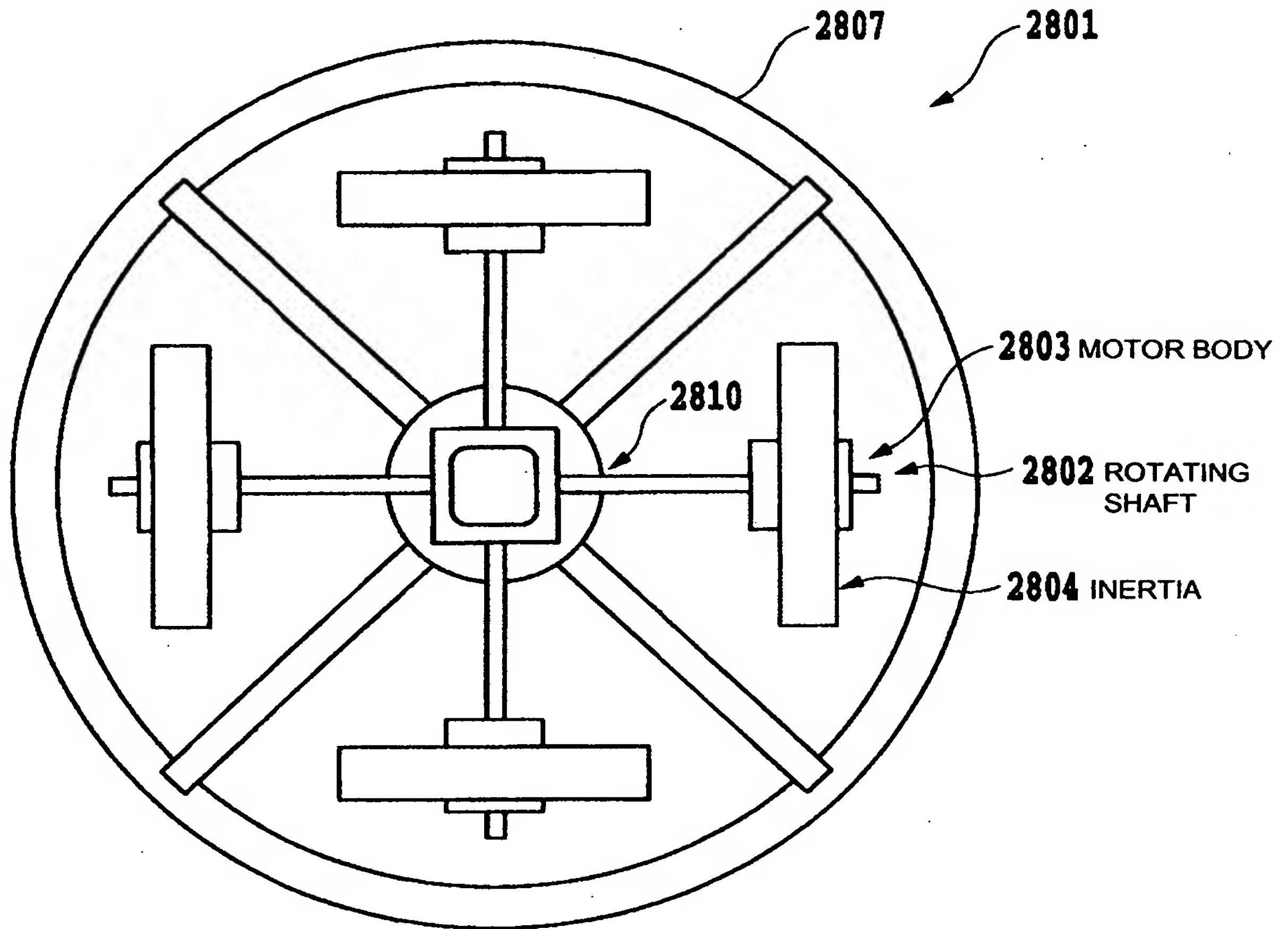


FIG. 2 9

TWO-DIMENSIONAL SECTIONAL VIEW OF HAPTIC PRESENTATION DEVICE
(EXPANSION MAY BE MADE TO THREE DIMENSIONS)

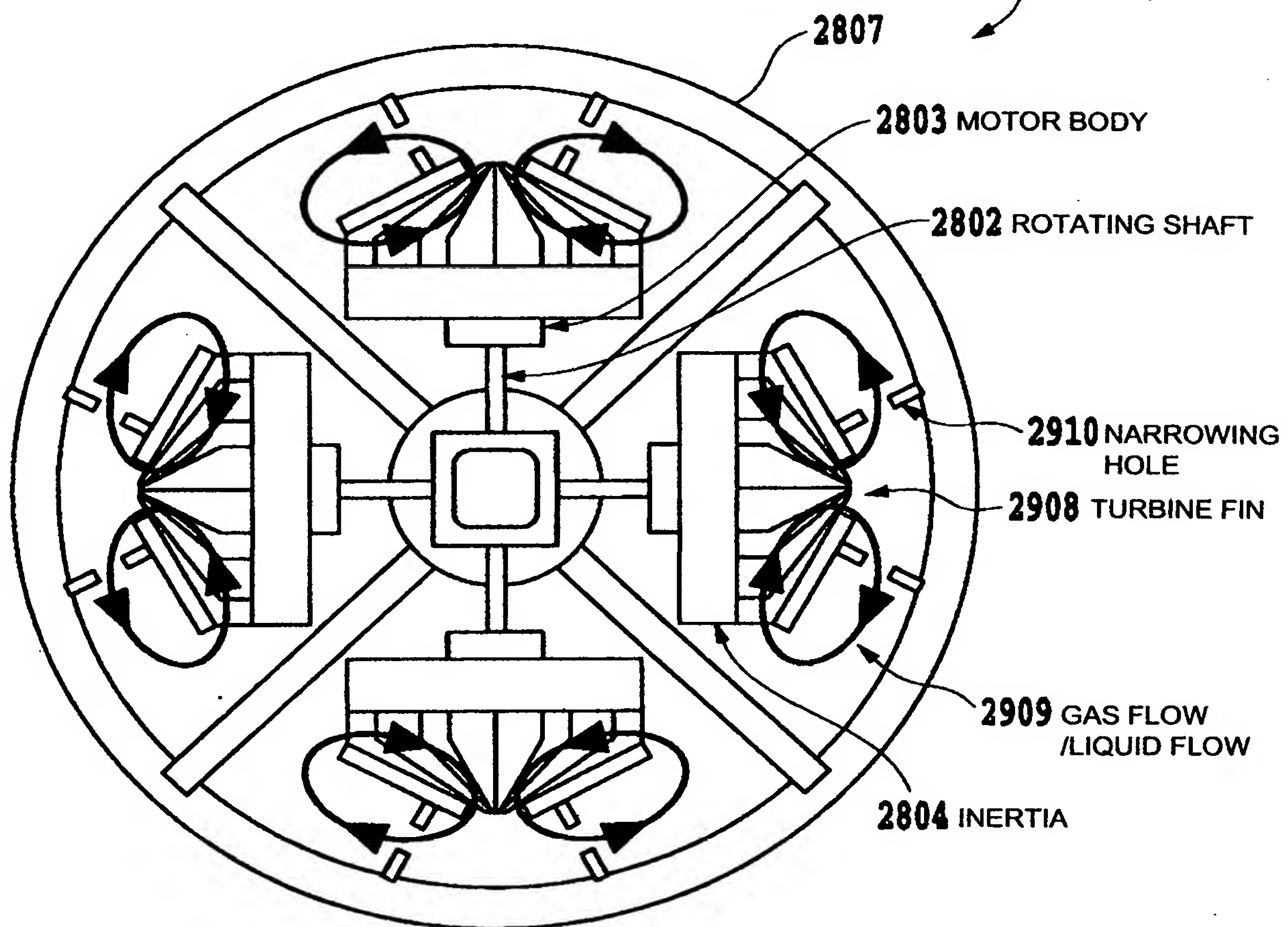


FIG. 3 0

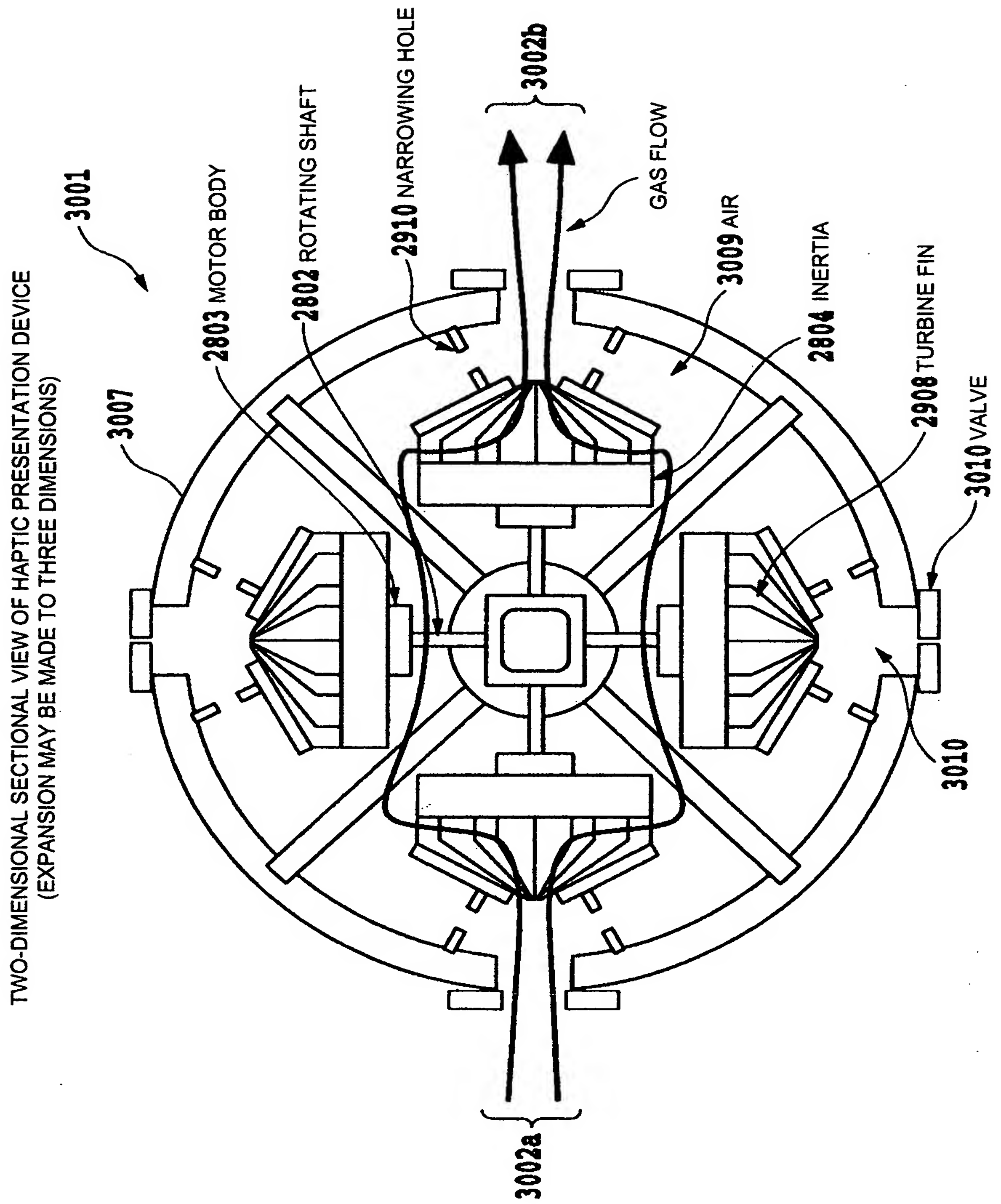


FIG. 3 1

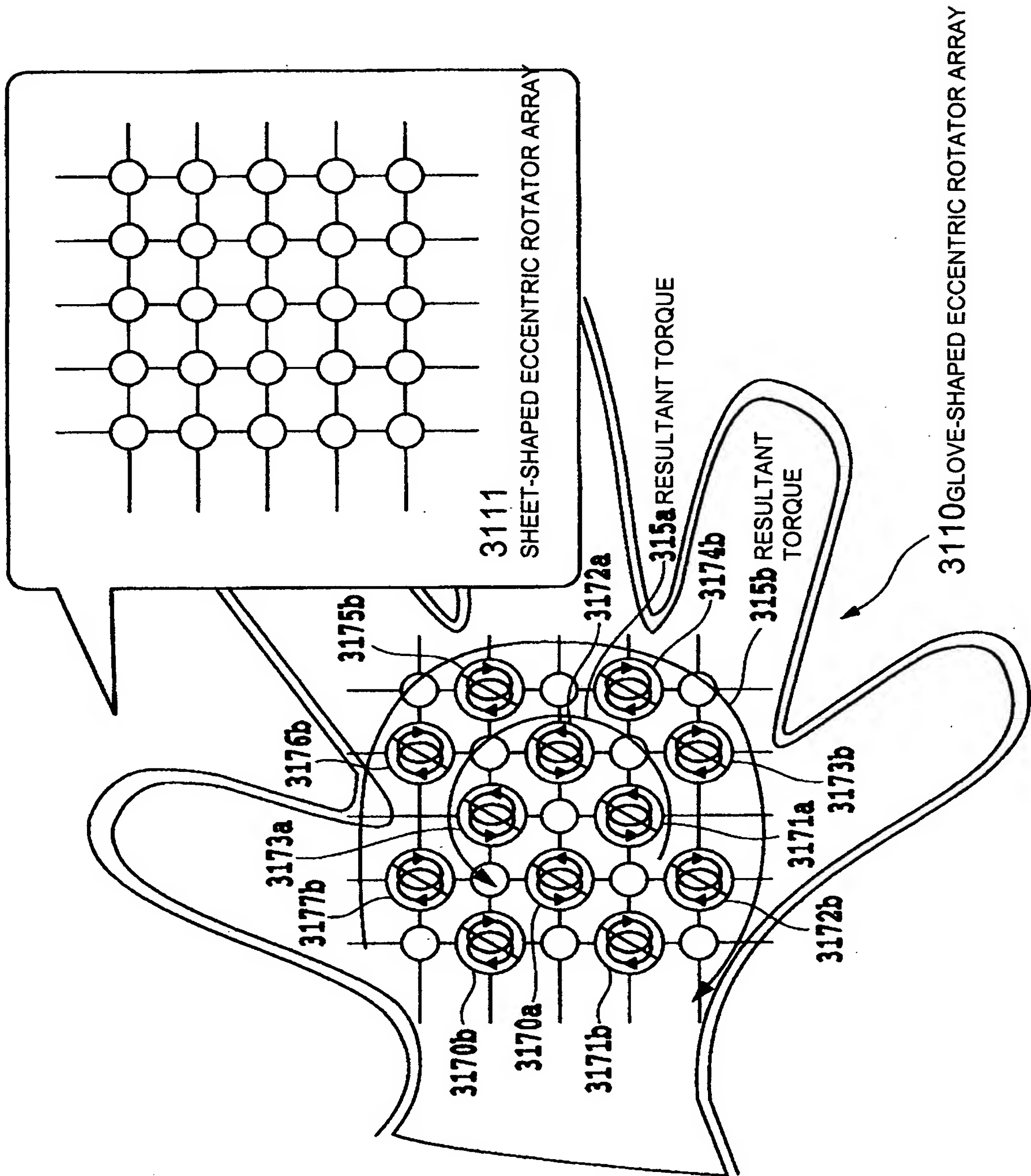


FIG. 3 2

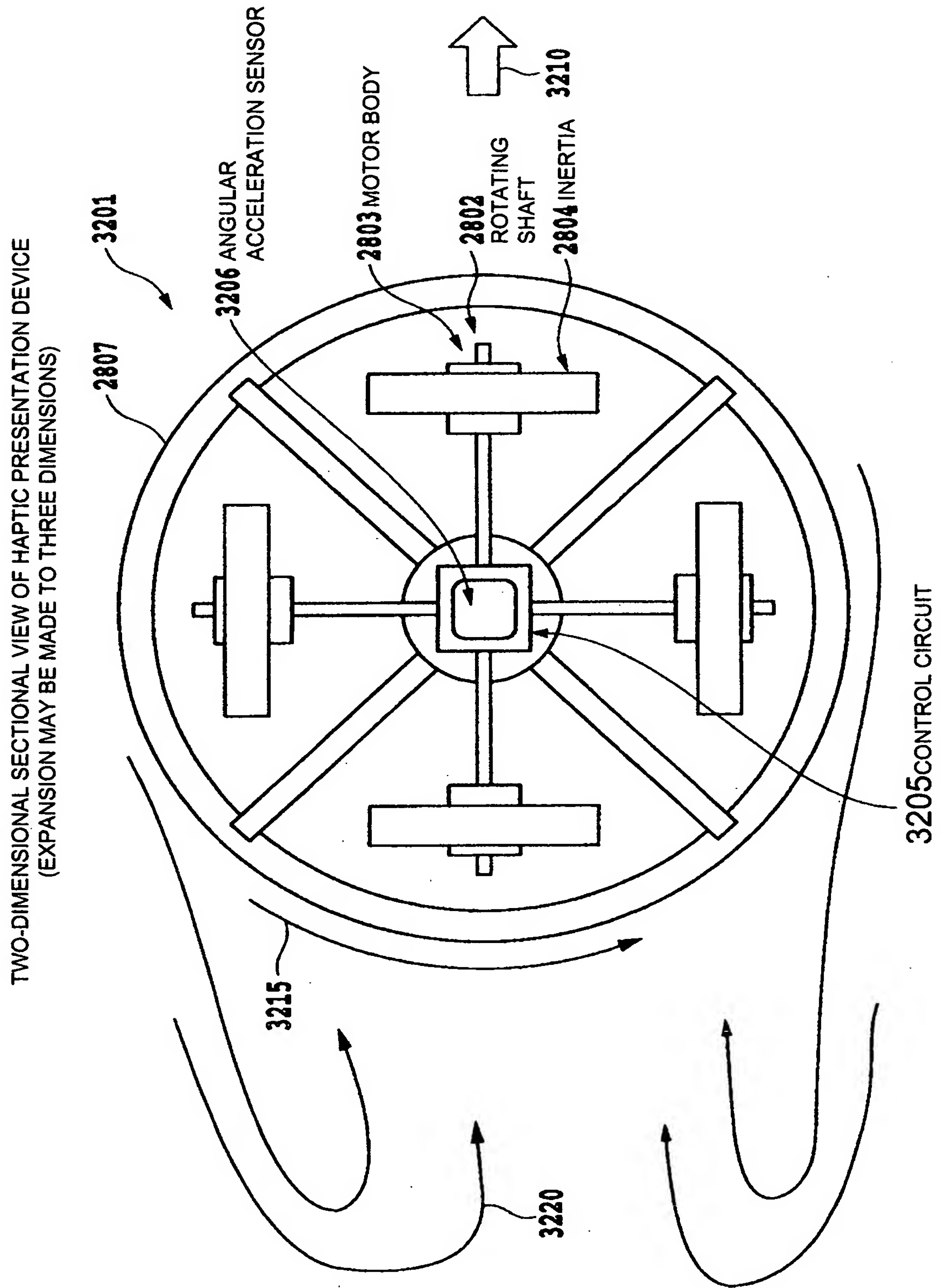


FIG. 3 3

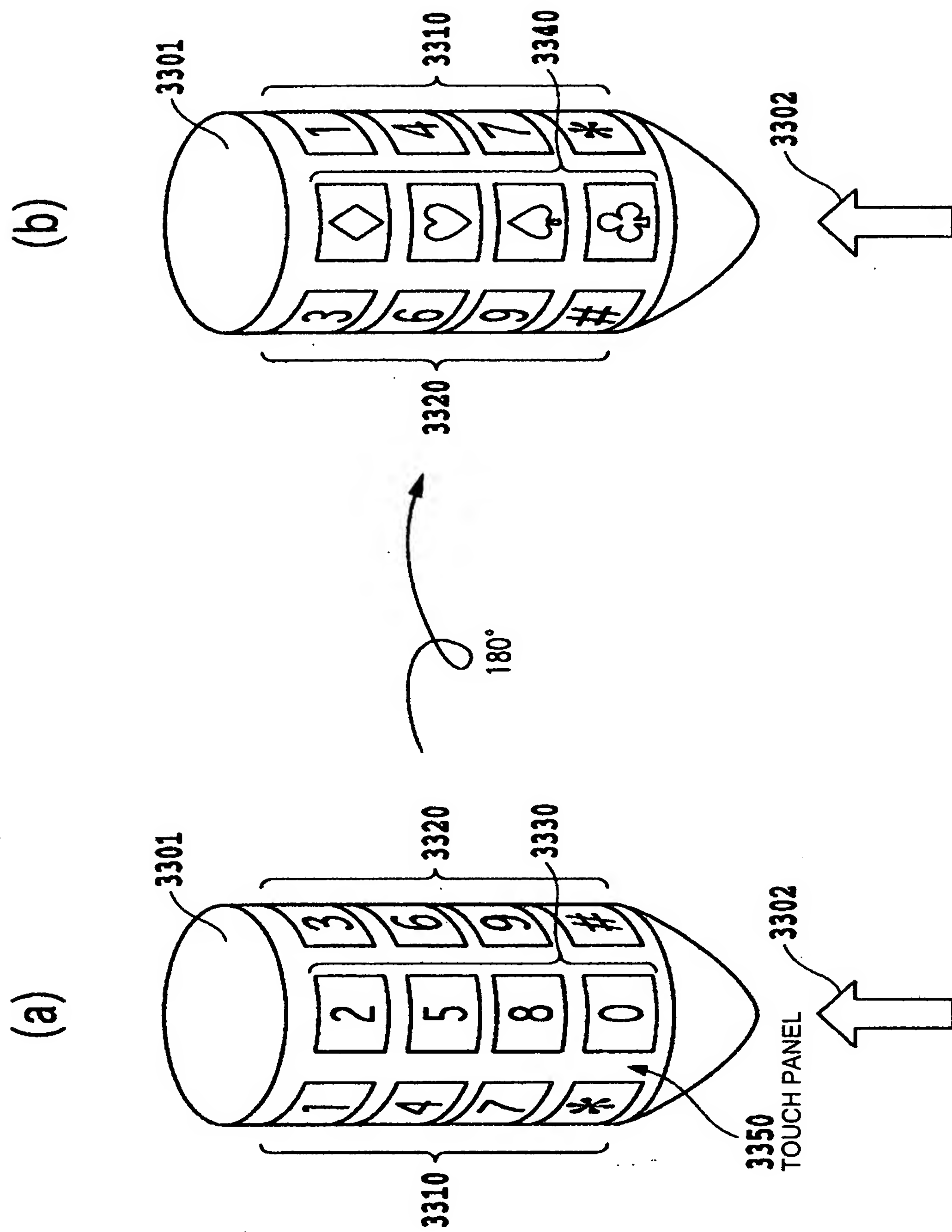


FIG. 3 4

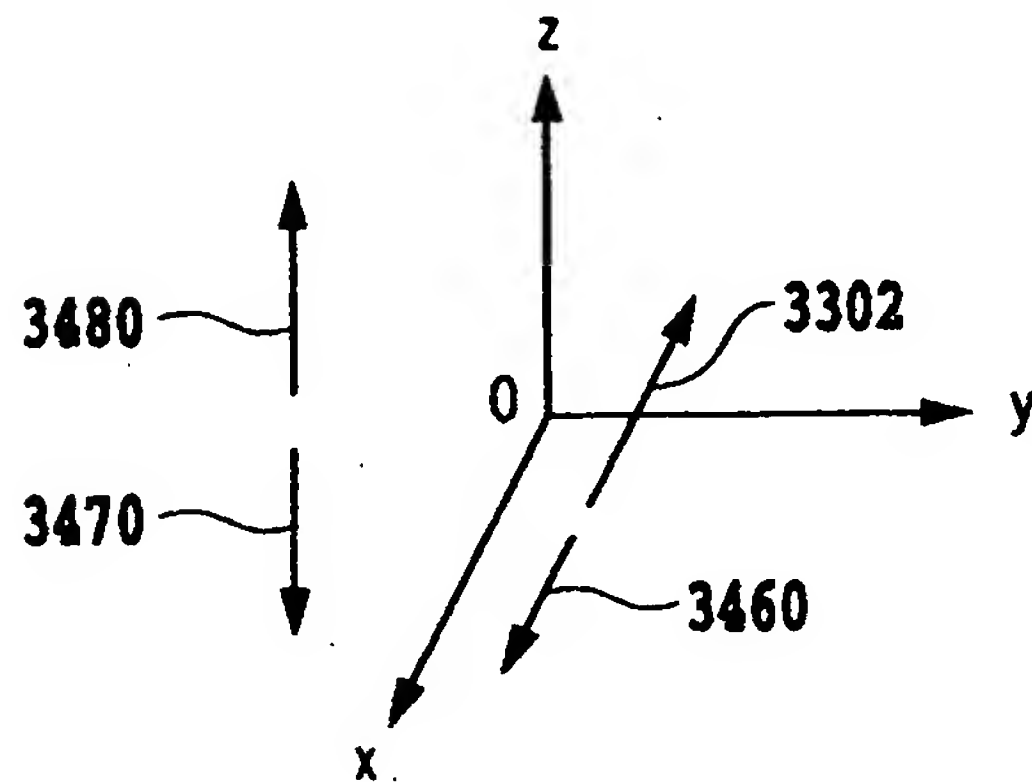
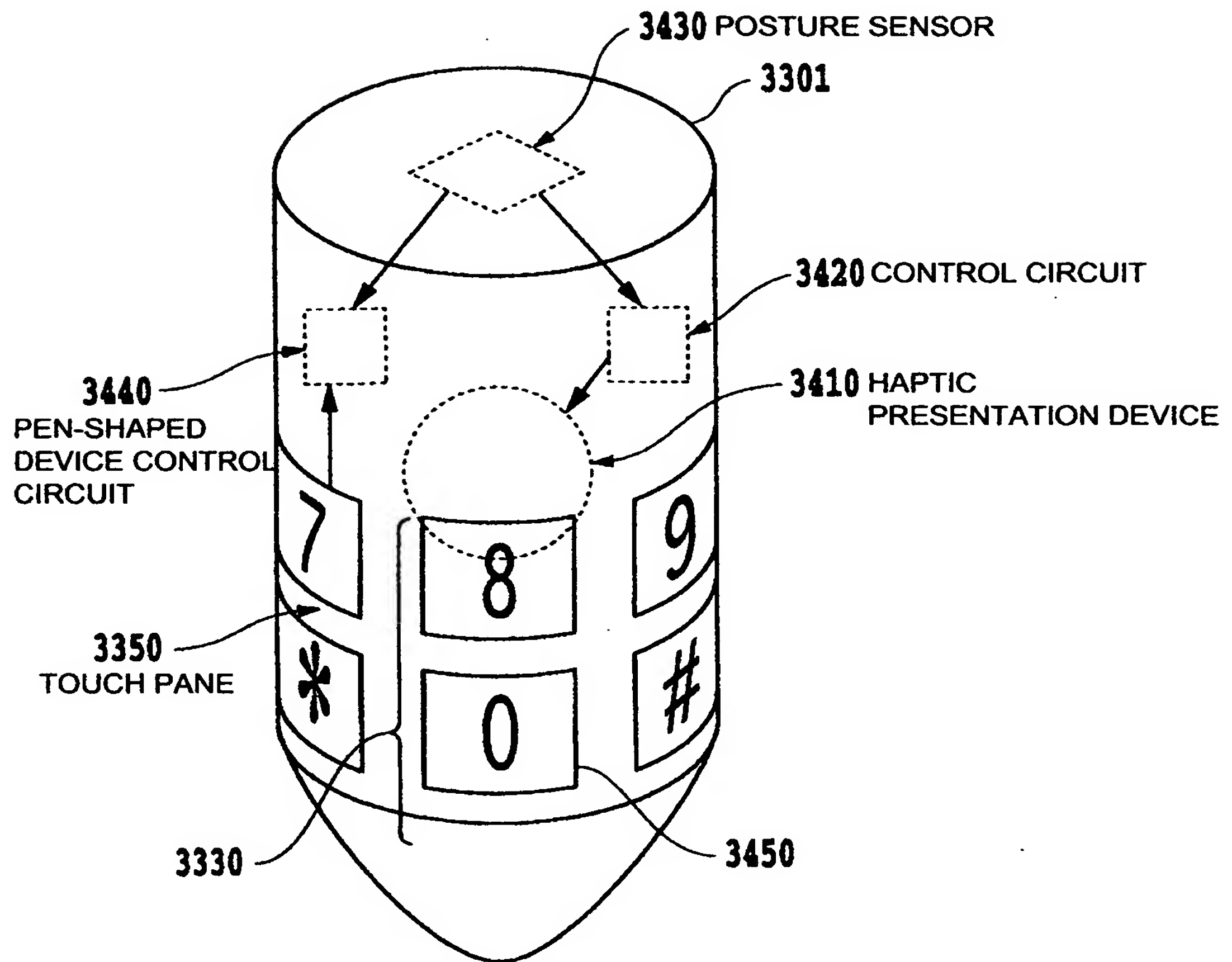


FIG. 3 5

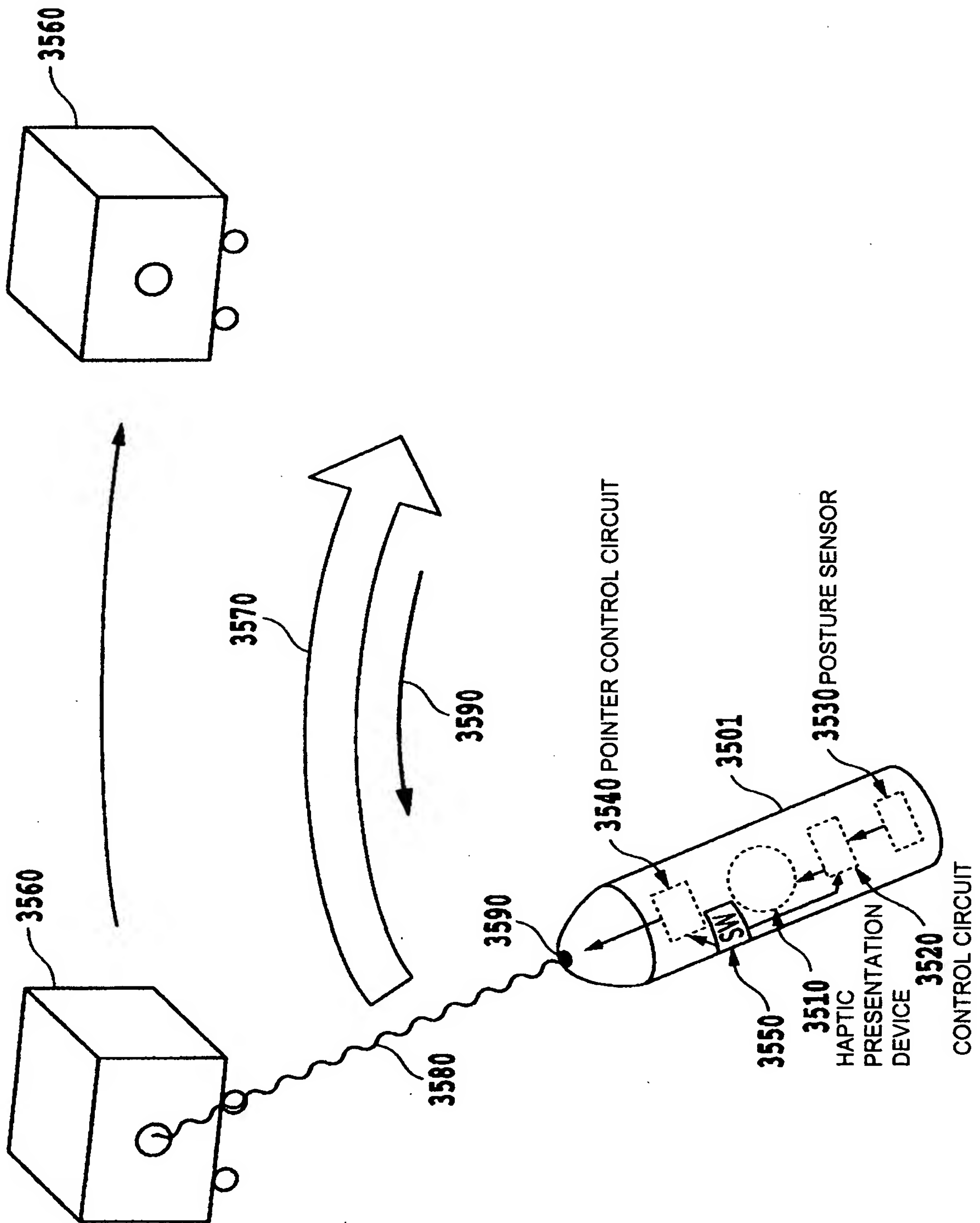


FIG. 3 6

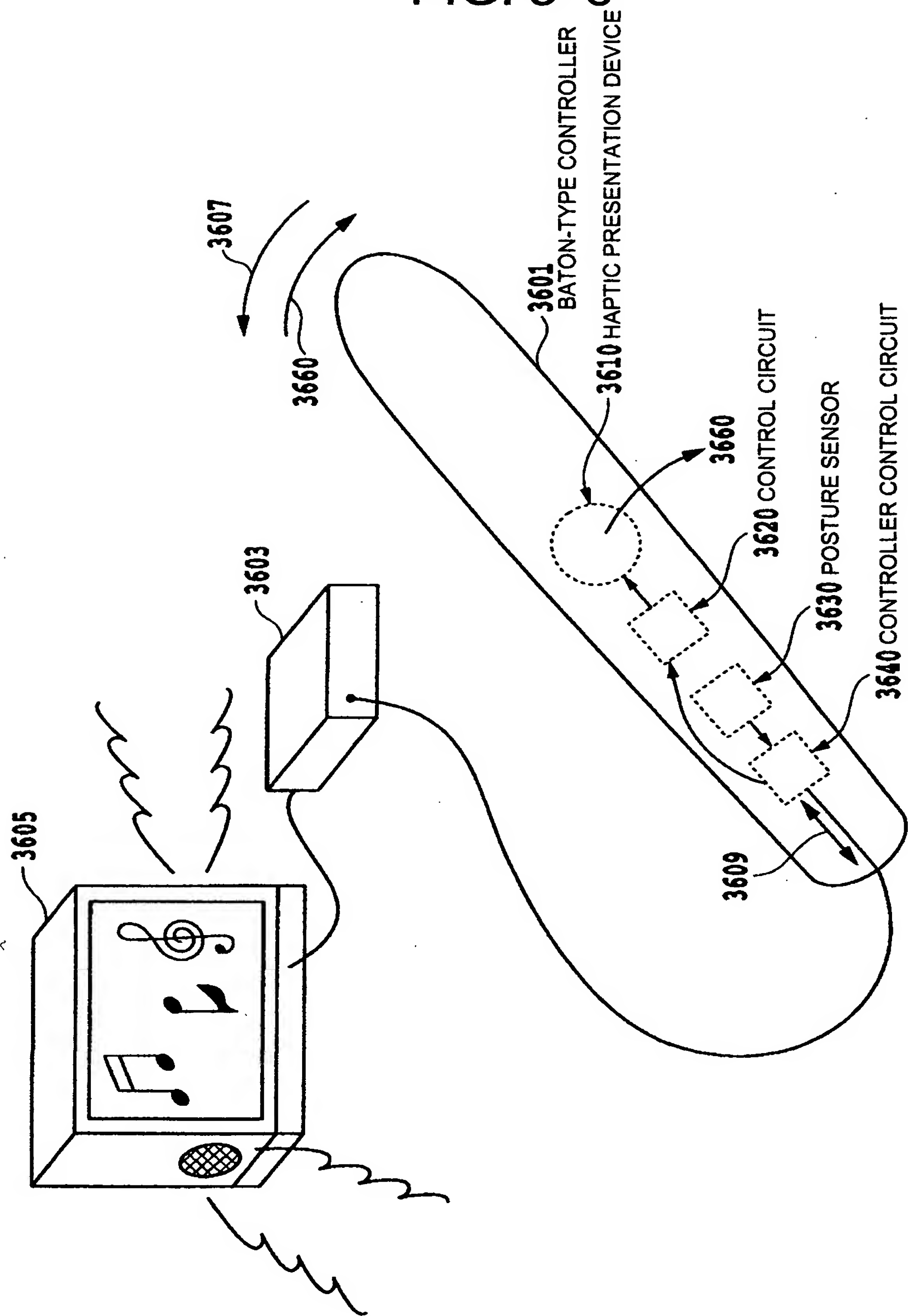


FIG. 3 7

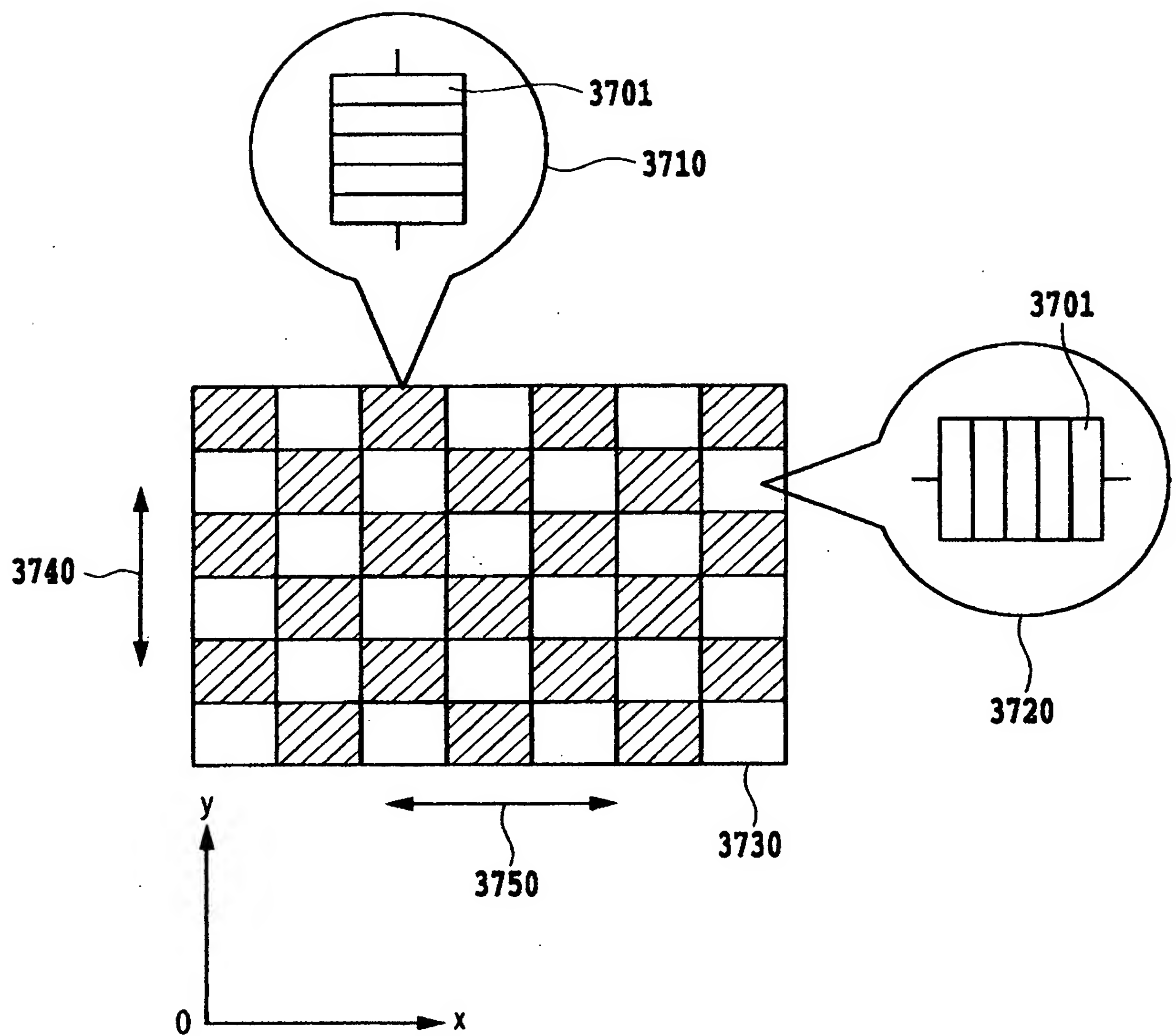
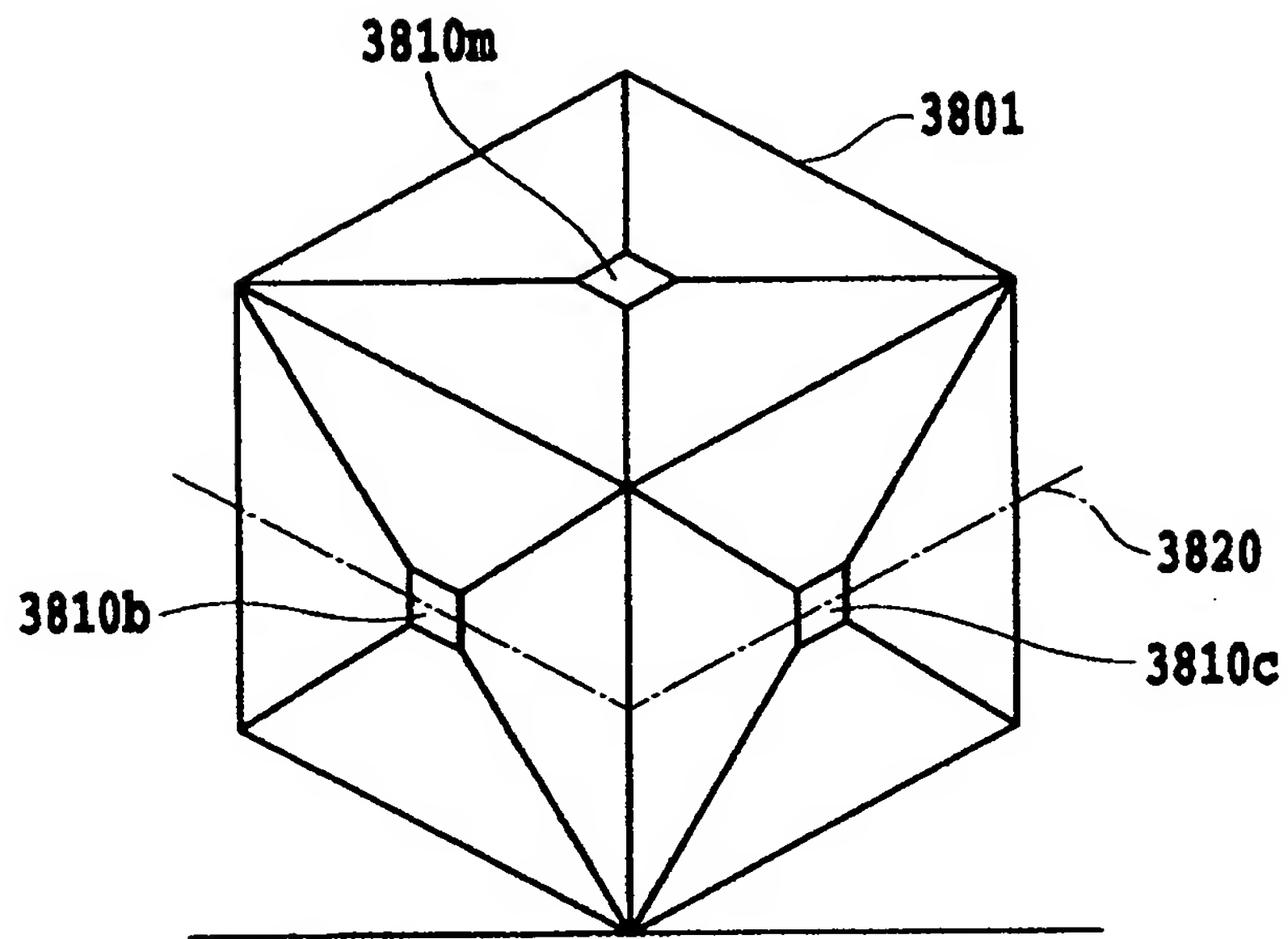


FIG. 3 8

(a)



(b)

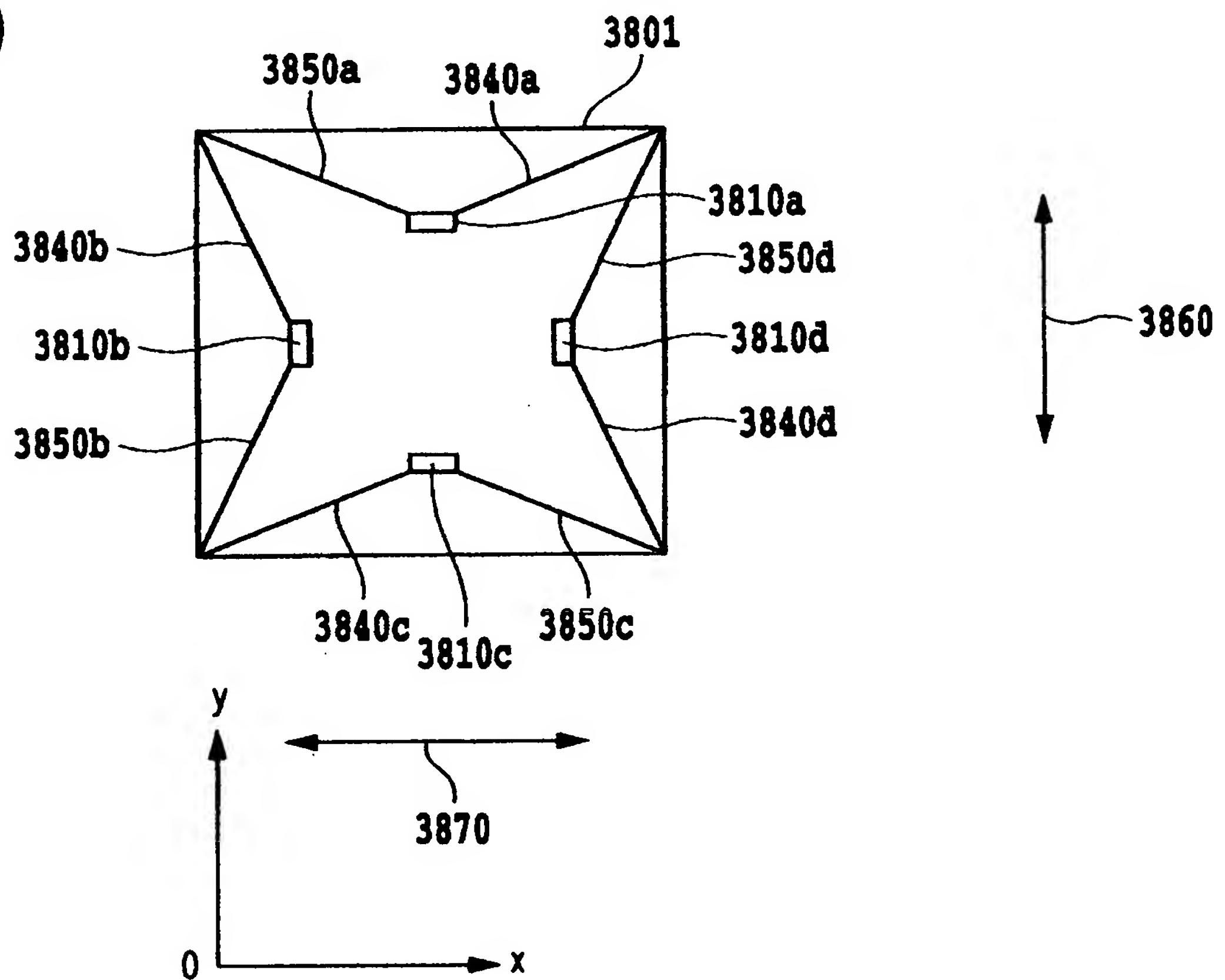


FIG. 3 9

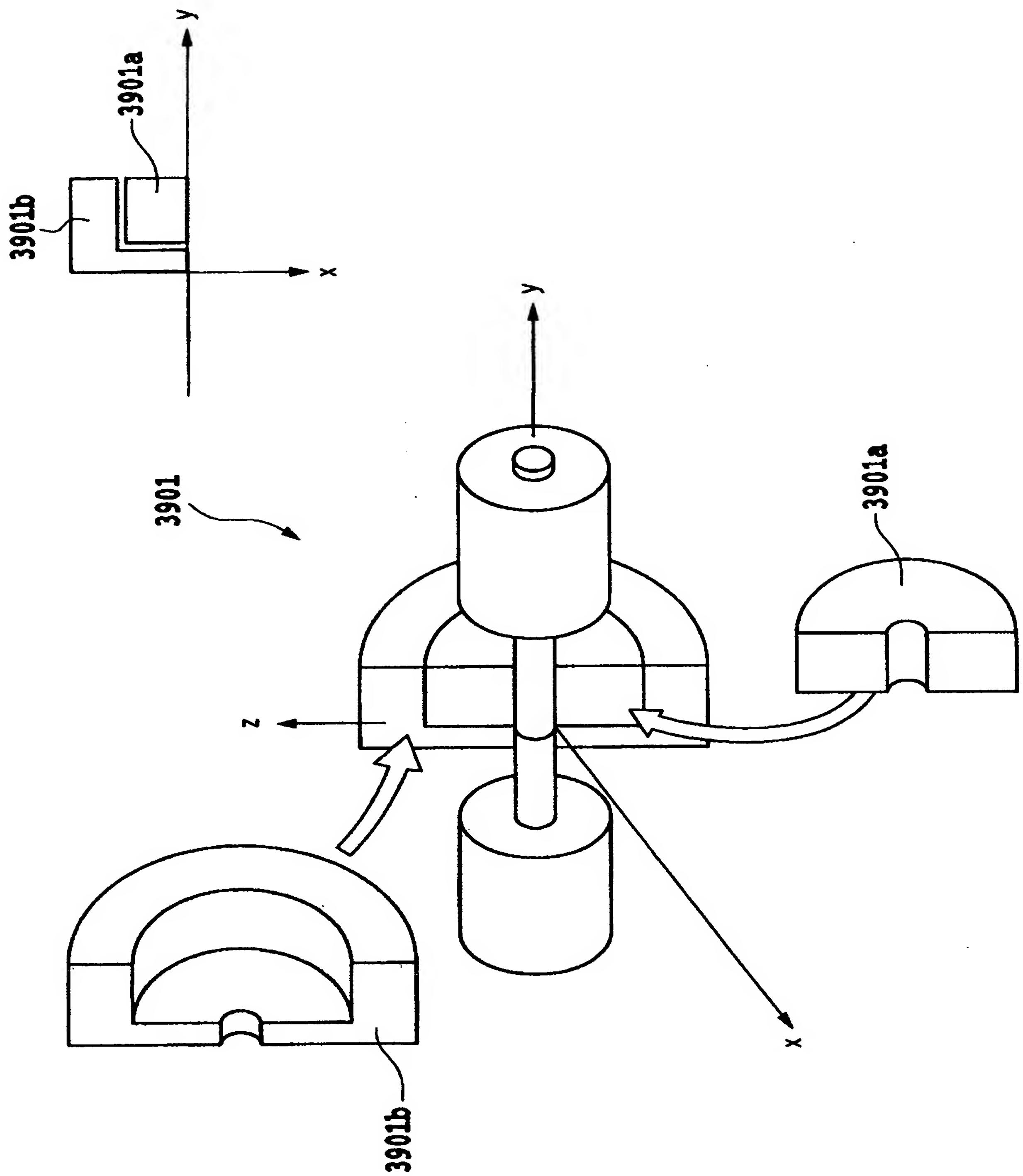


FIG. 4 0

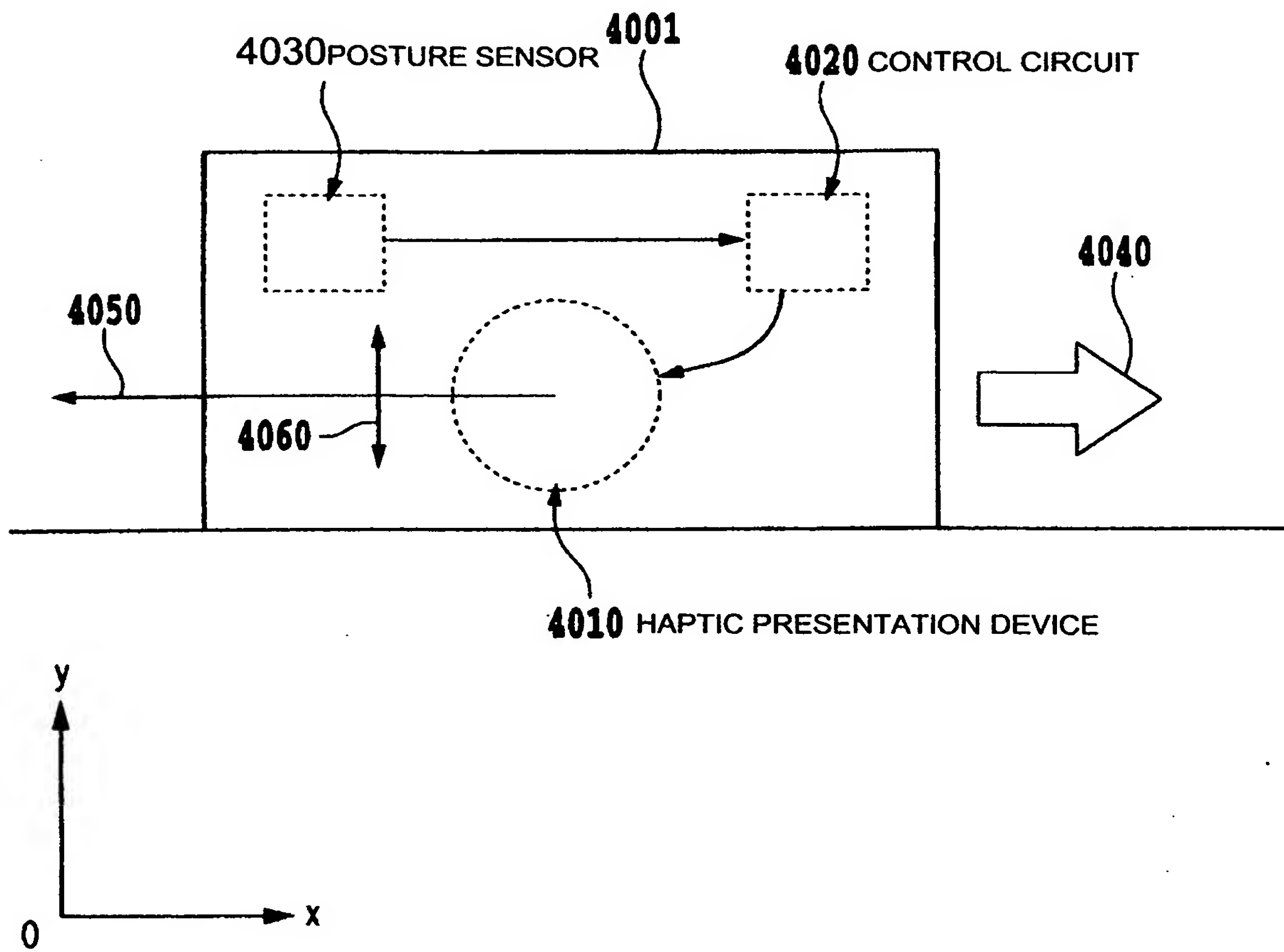


FIG. 4 1

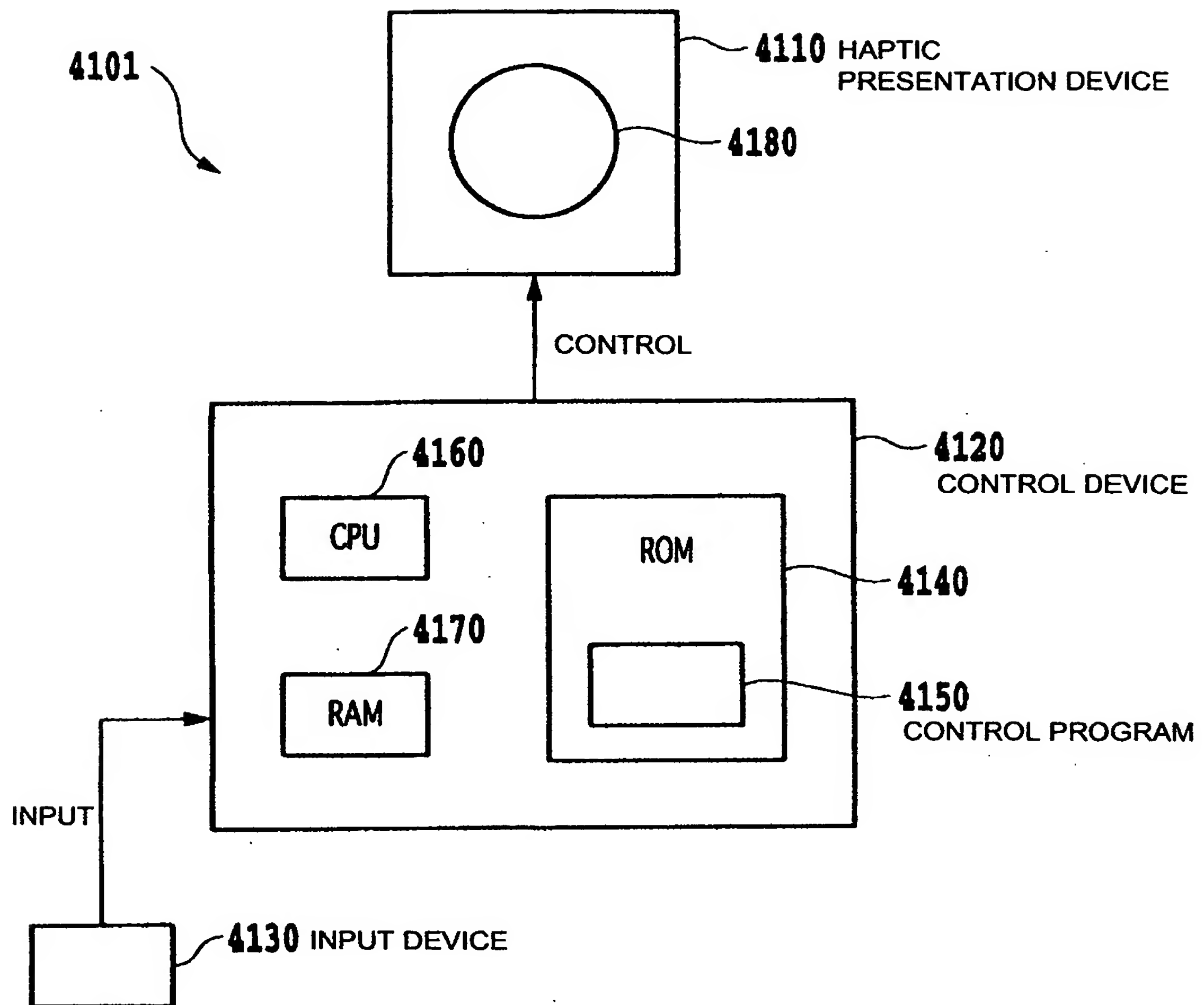


FIG. 4 2

